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SCRAP METALS

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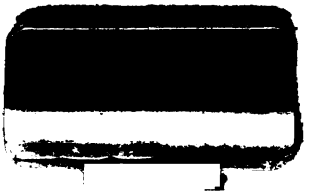

Scrap Metals

Scrap Metals

Study of Iron and Steel Old Material, Its Preparation and Markets

BY

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The Old Metals

BY

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FOREWORD

Though it is one of the most important raw material departments of the iron and steel world, the scrap industry has had no literature. Aside from day-to-day reports of conditions and prices in various market centers, nothing ever has been written about this great branch of supply. This modest presentation of the subject from various angles therefore is a pioneer effort, perhaps a cornerstone upon which a literature of scrap may be built. It is the earliest effort to present a broad review of the business. It originated in a series of articles printed in the DAILY IRON TRADE AND METAL MARKET REPORT during the past winter, further edited and collated to fit it better for book form and bring it up to date.

To friends in the industry thanks are returned for valuable suggestions that add much to its value. It is hoped the trade may approve this effort to increase the present growing appreciation of the real importance of this industry.

THE AUTHOR

Chicago, June, 1918.

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CHAPTER I

Importance of Scrap Industry

GATHERING, selling and utilizing iron and steel scrap is now one of the most important industries in the country, in many respects, and for its relative financial turnover it probably has more people engaged in its ramifications than any other.

Probably every boy who ever was a real boy has been engaged at some time and in some degree in assisting this industry by gathering old iron against the visit of the "rags and old iron" collector who traverses country road and city alley. The iron and steel thus collected brought and does bring only a tithe of the price for which it sells to its consumer; but the successive steps of handling or marketing add to its price steadily. The boy gathering it from out-of-the-way places and offering a small hoard to the peddler, performs his task without knowing that no one else can do it so well because to him the value of time does not exist.

This is a primitive end of the business, but it is valuable in that it starts a great stream of scattered bits sweeping toward the great consuming centers. There it is swallowed up as a valuable commodity, and comes through the mill or the foundry rejuvenated and in a new dress, serving mankind again as well as before it became scrap.

Because the industry devoted to gathering, sorting, preparing and marketing the vast tonnage of scrap is growing in importance and is taking on more and more the habiliments of a well regulated and scientifically ad-

ministered business, this volume designs to present some phases of the industry and discuss to some degree the myriad angles that have presented themselves in a study of the matter. All phases of the iron and steel industry touch in some degree the scrap market. Scarcely a new product in the iron and steel market does not have scrap as part of its constituents.

There is romance in scrap. The ancient alchemist sought to turn the baser metals into gold, not understanding as we do now that transmutation is chemically impossible. But the scrap industry has solved the problem from another direction, and scrap is transmuted into the gold that industry is willing to pay for service in presenting the scrap in form and condition to be used again.

Some things once used are lost forever in that form and must pass through nature's laboratory to become available again for man's use. Steel and iron scrap need no such long cycle but can be made available again at once and reappear in valuable forms by passing through one of the metallurgical processes which first made it of use. The number of times this operation can be repeated is unlimited and continued use and remelting does not change its character in the least.

Once the ore has been reduced to metal and made into some form of useful article, this metal can continue to the world's end to serve man unless it be lost in the depth of the sea or isolated in a position where the financial cost for its reclaiming is too great to make such recovery possible.

As the production of iron and steel has increased in this country, it has carried a corresponding enlargement

in the volume of scrap produced and consumed. The more stoves and cars and boilers are manufactured, the more become obsolete and useless in the natural course of events and thus the volume of scrap is increased. Conversely, the greater the demand for new iron and steel, the more is the demand for scrap to be mixed with the new pig iron to produce this output. One runs hand in hand with the other.

The tonnage of scrap is as important, ton for ton, as of pig iron, since it replaces that commodity and adds its volume to the total of iron the country finds it possible to produce.

Inasmuch as scrap may reappear many times in the course of a few years, a single ton of the original iron may serve to supply several tons of needed material which the facilities for smelting may not be able to meet.

Starting in a primitive way, the scrap business has retained many early customs, and some of the abuses that came naturally as a matter of growth have persisted after the industry assumed a dignity it did not command in its early days. These abuses have come about on both sides of the trade, both seller and buyer resorting in many cases to practices that have no place in real business. In later years these have been recognized as deterring factors and efforts have been made to weed them out, with much success. However, much remains to be done and this subject is assuming wide importance at present.

Irregularities in classification have grown up as scrap remained much of a local business; but these are being recognized as unsuited to the broader scope of the business, and efforts are being made to obtain standardization that

will serve in every center and make trading easier and more regular.

With its greater importance as one of the principal sources of raw material in the production of steel and iron, it has come about that the need is recognized for more businesslike methods and leaders in the industry are moving to bring about better conditions and hasten natural evolution that the best possible conditions may be realized at an early date.

An indication of the present recognition of the importance of the steel scrap business is found in the meeting of the American Iron and Steel institute in the fall of 1917 when an address on this subject was given place on the program for the first time in its history. The government had just given it recognition by including it in the subjects for price regulation, as important in its place as finished steel and pig iron.

Since it is the reclaiming of material temporarily without use or value to man, it is true conservation. It reduces the drain that otherwise would be made on the mineral wealth in the ground and staves off the day when this will be exhausted. Probably in no other line of conservation is the reclamation so complete. Coal burned is lost as coal and continues to exist only as gas, ash and power. Wood is burned or rots away and cannot be reclaimed. But metals continue as metals and do not lose their identity as such, no matter how many times they are used.

With a constantly increasing use of iron and steel, the volume of available scrap continues to increase and as years go on, it will grow in importance.

IMPORTANCE OF SCRAP INDUSTRY

From the "junk" collector of the alley to the dignity of the raw material from which ship armament, guns and shells and the finest grades of steel are made seems a far cry. But it is comprehended in the scope of the scrap business, and in the main road and the byways lurk many a story of interest to all who desire to have a full understanding of the greatest business of the country, the production of iron and steel in its myriad forms for peace and war. Without the use of scrap, it easily might come about that war preparations of the government might fail to be sufficient for its needs.

CHAPTER II

Sources and Collections

Sources from which scrap is derived are as varied as the places where iron and steel objects are used. Every article made of these materials is a prospect for the scrap pile, and only circumstances, varied in their nature, hasten or delay this fate.

From the farm, the household, the railroad and the manufacturing plant the stream has its beginnings. Some sources produce large tonnages steadily and can be relied on, while others have only small contributions and their assistance is relatively small. As a general rule, which may have its exceptions, the largest user of steel usually is the largest producer of scrap in wornout equipment or in discarded forms replaced by newer devices.

Following this rule, it comes about that railroads, which have been estimated to consume normally nearly half the iron and steel produced in this country, contribute the largest tonnage of scrap. As varied as the classes of iron and steel utilized by railroads, are the forms of scrap offered from this source.

The usual railroad scrap classification contains about 80 items to cover the various assortments into which the scrap is separated before being offered for sale. This has been refined as far as the demands of buyers have made necessary and railroad scrap usually is ready for the consumer without being sorted or prepared in the scrap dealer's yard. An exception to this may be found in

boilers, which may need cutting before selling; frogs, switches and guards, which may need to be cut apart; and bridge material, which often is sold without being cut up. Otherwise the railroad offering ordinarily is bought by a dealer on cars and sold without being seen, the producer being responsible for its condition and proper classification.

Among the forms marketed by railroads and ordinarily quoted in trade papers are the following: Steel rails, heavy melting steel, iron rails, boilers or boiler plates, knuckles, couplers, springs, grate bars, iron and steel axles, wrought iron, angle bars of steel and iron, pipes and flues, wheels, malleable, locomotive tires. This list might be extended several times, but other forms are of less importance.

Steel rails include long and short pieces separately classified; frogs, switches and guards. Short rails are used in the open-hearth furnace or the cupola, while the long rails are used for rerolling into bars and small structural shapes, an important industry having been built up on this basis. Heavy melting steel includes material suitable for the open-hearth furnace and must be within the prescribed limits, making it available for packing in the charging box. Boiler plates usually are cut up into smaller forms in the scrap yard before being marketed. Knuckles and couplers of steel are the finest sort of material for the steel foundry and usually command a high price from this class of buyers. Springs come into much the same classification, as they are high grade material, needing little attention in melting for fine quality steel. Iron and steel axles are available for heating and rolling like

small billets into bars and have a high value. Wrought scrap is used by bar iron mills, as it has the required analysis for puddling iron. Car wheels are really pig iron of a high grade and are used in place of new material in foundry cupola and in the open-hearth. Locomotive tires usually are cut into four pieces and heated, passed through a mill and reappear as bars for further use.

In the transformation of scrap into new material it often comes about that a railroad may buy back in new forms the material that only lately had been its scrap, renewed and given a new lease of life.

From the country dealer, who collects his material from many sources, come carloads of what is known as "country mixed," which must be worked over in the dealer's yard and classified to make it available for the consumer. In this are found parts of agricultural machinery, wrought scrap and hard and soft steel, as well as gray iron castings, stove plate, structural steel, and perhaps some machine shop scrap from small plants which do not produce sufficient to market it themselves. There are also parts of automobiles, wagon and buggy parts, and household scrap gathered by the itinerant collector in country and city.

From machine shops come borings and turnings of steel and iron, usually kept separate to increase their selling price. These are used largely in blast furnaces, being charged with the iron ore and entering the resulting pig iron as new material. In some cases these are compacted under pressure until they can be used in the foundry cupola. Boiler shops furnish punchings from rivet holes and trimmings from plates, which are low in phosphorus

and in great demand for use in the electric furnace and crucible.

Sheet metal works have a mass of sheet cuttings which must be baled or bundled before selling. When baled under high pressure, these are available for the open-hearth.

An important item of scrap which does not appear on the market is that produced in the steel mill as well as in both iron and steel foundries, and used again without being passed through other hands. In steel mills this consists of crop ends from billets and blooms, ends of rails, defective products, from the point of analysis or on account of flaws, and discards made necessary by close inspection. All these go back immediately to the open-hearth furnace or the converter and are remelted with new material. In the foundry there always is a supply of gates, risers and sprues cut from completed castings and used again in the cupola. This means a large aggregate tonnage that does not appear in the market at all. In the foundry there also is some tonnage of broken and defective castings which must be returned to the cupola and remelted. This probably is not properly classified as scrap, but it comes close to the line.

From this brief outline, it is seen that the origin of scrap is wherever metals and metal articles are used. When the usefulness of the article is past, it becomes scrap and then possesses value only as far as its metal is available as material from which some other form can be made.

Dirt has been defined broadly as matter out of place, its position giving it the name rather than any inherent quality. Scrap might be defined as metal whose use-

fulness in its present form has been lost. Its value as metal remains unimpaired and it becomes as valuable as ever when the operations of industry have given it a new form.

It is to the gathering of this material from its inappropriate location and putting it again into the channels of usefulness that the scrap industry addresses itself. It gathers, sorts, classifies, and sells to those who can use it profitably and render it of first grade service again. In the process of giving it new value, aside from its simple value as metal, every handler takes a share of the increment of value as his reward for services. This makes the scrap market.

Numerous factors have a bearing on the possibility of gathering and utilizing scrap. Unless the selling price will give a profit over the cost of gathering and transporting the waste material, it can not be made available. Except it be put into form to be used to advantage in melting, it will possess low value to the consumer.

As an illustration of the former situation an instance occurred several years ago in the west. A manufacturer of windmills found that throughout the territory he served there were many unused mills in various stages of dilapidation. He believed that they were poor advertisements and started to dismantle them, assuming the cost would be covered by their value as scrap. To his surprise he found that the cost of scrapping the mills was far beyond what he could realize from the material and he gave up the attempt. In that case the material really possessed no value. Should the farmer utilize time otherwise of no value he could realize a small return from

selling the old mills to the local scrap dealer, but dismantling the towers as a business would not pay a profit or even its cost.

A similar situation exists as to tin cans, which are sheet steel with a coating of tin. The greater proportion of these cans represent absolute loss of material. This runs into thousands of tons annually. They simply rust away and join the soil, lost forever. It costs too much to collect them. However, where the cans are collected in cities as an incident to garbage and rubbish removal service, and are available in large masses at one point, they can be used at a profit. In this case, the expense of collection is borne for the sake of removing them and when they are cost free to the user except for transportation, they can be reclaimed.

The presence of tin and solder on the cans has been a deterrent, but recently experiments have been successful in detinning the steel, the tin and solder being valuable and the steel sheets remaining as a by-product.

Unless there be a market for scrap within a distance where the freight transportation charge will not equal or exceed the selling price, the scrap cannot be marketed. In the far west there are places where the collection of scrap is practically without profit because it has no outlet except at such a distance that carrying charges eliminate all gain.

Putting waste material into form for use has been developed greatly in the past few years. For a long time wire, sheets and clippings and fine scrap, borings and turnings, were difficult to handle because of the excessive losses in the furnace from oxidation before melting could

be accomplished. With a loose mass lacking cohesion, much of the material oxidized was lost as metal.

Bundling of sheet clippings into bales made them somewhat more available and saved much of this steel, but more recently balers operated by hydraulic power which compress the scrap almost to solidity and exclude the greater part of the voids have come onto the market and made this material much more available. By this means a great deal of scrap formerly not of much use is now a valuable commodity.

Along a similar line there have been efforts for many years, now apparently successful, to compress borings and turnings into briquets which will hold together until melted instead of falling through the bed in the cupola. Immense pressure is necessary to effect this compacting and the difficulty has been to make the process sufficiently cheap to be of practical use.

The range of price in the scrap market is a great factor in making available the material which may be collected. A few years ago when the general level of all materials was low, borings and turnings commanded so small a price that an instance is known of a large producer of this form of scrap refusing even to load it into cars, using it as filling in his shop yard. It was cheaper than dirt in that case. A year later it would have paid him to have used a steam shovel to mine the material and sell it, except that it was oxidized and mixed with the soil.

When prices began to climb at the beginning of the European war, there were vast stores of scrap in the hands of country dealers who had picked it up cheaply and held for a rise. It was possible to visit any town which had

a scrap dealer and pick up several carloads on which he would make a handsome return at the advanced figures. As this accumulation was called on to supply the heavy demand arising from enlarged operations of mills and foundries, this reservoir began to run low and the sentimental effect of this was to give still higher prices, the visible supply being reduced. Country dealers then began gathering everything available and selling at once and the situation soon was that there was practically no available supply in the rural districts away from consuming centers. This was a factor in keeping quotations at their high level.

On another low market with light demand and small profits, this reservoir probably will begin to fill again for the next heavy demand. Higher prices thus increased the supply in calling out hoards held for a profit. Increased cost of material had an opposite effect in another direction. Many railroads have established reclaiming plants in connection with their scrap yards. Through these it has been possible to reclaim much material that still possessed a value as railroad supplies above its scrap selling price. However, it was found after a time that some reclaiming was not a profitable process and part of the effort was relaxed, attention being given only to the profitable portion and the other material was allowed to go out for scrap, as new supplies were of low cost. When steel prices began to soar and deliveries were extended, making new material difficult to obtain, the situation had to be recast. Reclaiming that had been unprofitable became of great profit, and the bolts and car parts formerly cast aside as not sufficiently valuable to

have work put on them for further use became doubly valuable, for two reasons. They could take the place of new material that cost a great deal, and they could be made available for repair work at once while new parts could be obtained only after long wait.

This had the effect of limiting to some degree the tonnage available from railroads, which already have been set forth as the largest producers of scrap material.

High prices of scrap gave railroads some unexpected profits. While the cost of standard steel rails for years was $28 to $30 per ton, and then advanced $10 above that figure, the price that has been realized for used rails as rerolling stock has been much higher than the original cost of the steel, thus giving back to the railroads an actual money profit after they had had the use of the rails for years in their tracks.

The price level thus modifies the situation in many ways and changes conditions to a degree that what has been valueless becomes productive of sufficient profit to pay for handling it.

CHAPTER III

Tonnage is Enormous

To determine the annual total tonnage of scrap in this country presents many difficulties, inasmuch as it is so diffused a material and is handled by so many individuals and through such irregular channels.

However, it may be stated as a generalization, which falls far short of the mark, that the tonnage of scrap utilized in this country is at least equal to the total tonnage output of all steel and iron foundries. This conclusion is arrived at in this way. The total production of pig iron in 1916 in the United States was 39,434,797 tons. The total production of steel ingots was 41,401,917 tons in the same year. This gives a preponderance of 2,000,000 tons of ingots over pig iron. But of the pig iron 6,475,130 tons were foundry and malleable, which did not enter into the making of steel.

Inasmuch as pig iron and scrap form the only sources from which steel can be made, it follows that the total scrap business of this country must have been at least as large as the total of foundry and malleable pig iron plus the 2,000,000 tons excess of steel over pig iron. This gives a total of 8,475,000 tons. But this is not all, for there is also to be considered the scrap used in gray iron foundries, steel foundries, rerolling mills, crucible and electric steel plants.

In an address before the American Iron and Steel institute, in 1917, W. Vernon Phillips, of Philadelphia, the

first speaker ever to present this subject before that body, estimated the gross consumption of scrap in 1916 at 12,000,000 tons, exclusive of borings and turnings used in blast furnaces. He estimates that in 1917 additional demand for enlarged open-hearth operations would bring the total to 15,000,000 tons. Mr. Phillips stated that about 9,600,000 tons of scrap were melted in open-hearth furnaces, about 2,000,000 tons in rolling mills producing bar iron and muck bar and soft steel, while about 600,000 tons were consumed by rerolling mills, using rails, axles, shafting and such material.

Thus it appears that the total tonnage of scrap handled by this industry is almost equal to a quarter of the tonnage of iron ore brought from the Lake Superior district and is equal to about one-third of the total tonnage of pig iron and steel produced in this country. It thus assumes a prominence putting it among the largest industries of the country and one which is worthy of much attention, inasmuch as it is entirely a utilization of what otherwise would be waste.

Tonnage figures give only a part of the perspective and serve only to set the industry in its proper place among its allied interests. The work of collecting, sorting and preparing the scrap employs a small army and in this army are all grades of intelligence from the humble private, represented by the "junk" collector, to the general, the dealer, who directs the units of a business which handles thousands of tons of material valued at millions of dollars in a year.

Firms organized to handle the business in a large way do not possess great plants that strike the eye nor do

they become known to the public through their products. Yet their operations in a year involve great sums and their success or lack of success depends almost entirely upon keen judgment of conditions, ability to grasp and forecast, to buy right and to sell when the market is favorable. Yet their stock is not of a nature that can be held long for a rise and usually must be moved at once to keep business active. The margin on which the business is done is not wide and losses are met along with the profits.

Without the collection and utilization of scrap the production of iron and steel would be greatly reduced. It would be necessary for mining and transportation to be greatly enlarged to bring down more ore from the mines and more blast furnaces would be necessary or there would not be sufficient raw material for steel works and foundries to use in making the necessary products demanded by the country's industry.

That it is a highly necessary function is proved by the sharp advance in prices which followed the increased demand for steel that came with the opening of the European war. The aid to production given by the availability of scrap cannot be measured but its need is manifested in the fact that reserves in first hands were called forth and largely depleted to make up the tonnage needed from mills and foundries. Without the machinery of collection and sale of discarded material, the total would have fallen far short of the point it attained and to scrap is due the millions of tons of steel and iron turned out in excess of the total tonnage of new iron made in blast furnaces.

Certain centers become natural gathering places for scrap as it is collected and started toward its destination. Thus the country dealer usually has an outlet through his largest neighboring city in the direction of general scrap movement. These dealers, in turn, usually have a connection in one of the real consuming centers where the scrap is consigned and diverted to the actual consumer.

Thus in the West scrap gravitates toward Kansas City, Minneapolis or St. Paul, St. Louis and such other cities, and then usually it is taken by Chicago dealers, though some is absorbed by local consumers at those points. Chicago is the great scrap center of the West, the first that is encountered by the stream as it moves eastward into the steel and iron section that lies north of the Ohio and east of the Mississippi.

With the steel and iron mills, foundries of all sorts in and within reach of Chicago on every side, including the great steel foundry interests at Milwaukee, this center absorbs tremendous tonnages of all varieties of scrap from a wide territory to the West, northwest and southwest. Western railroads start scrap collection at the farther terminals and keep it moving eastward until Chicago is reached, where it usually is prepared for sale and lists issued to dealers and consumers.

Farther east the territory from which a consuming center draws is not so large, as the density of steel plant centers increases markedly. Thus Cleveland, the Valleys, Pittsburgh and Buffalo each has its own scrap territory, much less in area than that west of Chicago. As a result of this more crowded condition, competition for scrap in the east usually is keener than it is in the West, though

the production of scrap is proportionately greater in the more highly organized industrial areas in the East. Usually it is possible for scrap to be shipped from the West to the East, on account of the greater demand there, which absorbs so tremendous a tonnage, often far beyond what is produced in the natural territory from which supplies are drawn.

It probably is due to this onesided situation that numerous railroads in the West have established rolling mills to utilize scrap and produce their own bar iron. This is more profitable than shipping the scrap East.

This fact also doubtless has had much to do with the establishment of bar iron mills and rerolling mills at or west of Chicago. They are able to command the tide of scrap from farther west and the shipper also is able to obtain better prices than would be the case if he were forced to depend upon the East for his only market.

As now organized, the scrap gathering and marketing system converges to the larger centers in an eastward direction almost entirely, barring local exceptions; and the consuming centers simply tap the stream as it moves east, taking out what is needed, the remainder moving onward when price conditions are such that shipments can be made profitably.

New England produces about 5 per cent and consumes 1 per cent of the country's supply of scrap, so that the tonnage moving from that district always is of considerable proportions. About 75 per cent of the heavy melting steel produced there normally moves to the Pittsburgh district, although some of this tonnage occasionally is diverted to eastern Pennsylvania. The remaining 25 per

cent of the heavy melting steel output is consumed by steel plants in that district. Of grades other than heavy melting steel, about 90 per cent of the tonnage shipped from New England goes to eastern Pennsylvania. The only grade which New England brings in from outside on a noteworthy scale is low phosphorus scrap. It also brings in cast scrap occasionally. As in all districts which are more or less remote from blast furnaces, material premiums are obtained for the latter trade over the prices prevailing in districts more favorably located.

Low phosphorus scrap at all times commands higher prices in the East than in other sections of the country. Only three or four eastern mills sell this grade, and the tonnage they have to offer is far from adequate to the requirements of the acid steel casting plants in that region. As a result there always is a scarcity of low phosphorus steel in the East. Owing to the conditions prevailing during the war, this scarcity not only has become accentuated but also has extended to other sections of the country.

Plate makers have been selling their low phosphorus scrap on a smaller scale, since the shortage of pig iron has made it necessary for them to conserve metal as much as possible. Consumers of low phosphorus scrap, therefore, have been forced to depend to a large extent upon grades which they would not consider under normal conditions. This situation necessitated recognition by the American Iron and Steel institute, which accordingly amplified the price schedule on low phosphorus scrap. The revised price schedule which was issued on Feb. 21, 1918, accordingly fixed maximum prices on three grades of low phosphorus scrap. Grade A includes billet, bloom, bar

and plate crop-ends, axle butts and new mill plate shearings ¼-inch thick and heavier, which will analyze 0.04 per cent and under in both phosphorus and sulphur, and is to be used only in plants operating acid open-hearth furnaces, crucibles or electric furnaces. Grade B includes all other grades to be used in such plants, which will analyze 0.04 and under in both phosphorus and sulphur. Grade C includes special steel for use in such plants, but which will not analyze under 0.04 in phosphorus and sulphur. The latter grade includes steel knuckles and couplers, rolled steel wheels, railway steel springs, carbon tool steel and material similar in quality and character.

A feature of the low phosphorus scrap market under war conditions was a growing demand, from acid electric furnaces and blast furnaces making low phosphorus pig iron, for low phosphorus turnings. Such blast furnaces, in view of the scarcity of low phosphorus ore, were eager to take all the low phosphorus turnings offered.

Another grade which is scarce in the East is wrought scrap. Whereas the requirements of iron rolling mills are larger than in other sections, the production of this grade is relatively smaller in the East than elsewhere. Eastern mills manage to find enough wrought scrap to fill only about 50 per cent of their requirements on the average. As a result prices of wrought scrap, and particularly No. 1 railroad wrought, are higher in the East than in the West. Iron and steel axles, which are used for rerolling and sometimes for forging, usually command comparatively higher prices in the East. Due to the greater number of forges in the East, forge scrap for making charcoal iron generally brings a better price in the

East than elsewhere. Prices of cast scrap also usually are higher in the East than in the West.

Heavy melting steel, on the other hand, usually is lower in price in the East than in the Pittsburgh district. This, of course, is due to the fact that Pittsburgh, which consumes 44 per cent of the country's output of heavy melting steel, always is hungry for this grade. Hence, whenever the disparity of prices is pronounced, heavy melting steel moves from the East to Pittsburgh until the slack is taken up.

CHAPTER IV

Classification and Its Importance

To be useful to the consumer, scrap must be sorted out into various grades, according to its size, its analysis and its condition as to cleanliness and rust. The dealer who gathers it from its original source finds it a heterogeneous mass of many kinds, and were he to market it in that form he would receive a price much lower than would be realized were it separated into grades. All dealers who have sufficient tonnage to make this worth while do this assorting and ship straight carloads, as far as possible. Railroads keep each kind separate and market it carefully, thus getting the highest price.

With the scrap well classified, the seller and the buyer know exactly what is being dealt in and the consumer knows from experience what he is buying. Specifications vary to some extent among producers and users, though there is a degree of agreement the country over, local conditions and special needs making variations from time to time.

This condition did not always obtain, and until 1906 there was lack of agreement that made much trouble. At that time the Railway Storekeepers' association met with a number of important consumers and together worked out a classification that is as near standard in actual use as has been achieved. This was issued Aug. 1, 1906, and ever since then has been used as standard by most railroads in this country as well as by a large

number of consumers. This schedule has been amended at least twice since it was first formulated and slight changes are made from time to time as need arises.

A few railroads have classifications of their own based upon the storekeepers' list in the main but varying in some details. The secretary of this association is J. P. Murphy, with an office in Collinwood, O.

So high a standing has this classification gained through the years it has been in use that it is referred to as standard and many steel companies have adopted it in entirety.

Of course, there are many grades of scrap not produced by railroads and these have been given no place in this list. On these grades it is necessary to have additional specifications, but for the most part scrap produced elsewhere than on railroads, will be found to fit into the railroad classification easily and thus no trouble is met.

Reference to the storekeepers' classification shows there are 67 classes. In addition to these items, covering only iron and steel, there are about 30 additional items covering old metals and other waste materials. The subject of classification is broad and contains many angles. For purposes of reference, the storekeepers' association specifications will be found in the appendix.

One of the great advantages in a standard classification is that a basis is afforded for the settlement of disputes which may arise over the quality of a shipment. Brokers and dealers can rest their argument on a stable foundation of general agreement as to the makeup of a certain classification. On the other hand, a buyer finding the scrap delivered to him does not conform to the

generally agreed specifications, has a real argument to support rejection.

The existence of a specification forms a fixed basis for negotiations and eliminates much argument in case of dispute.

Progress in standardization has been slow, but much has been accomplished. Much remains to be done, and efforts are being directed constantly toward this end.

Comparison of the standards fixed by various consumers shows a general agreement which argues strongly for eventual harmony that will leave few loose ends. The consumer is the arbiter of all classifications. He is buying the material and the seller must sort and prepare the scrap to suit him.

This being the case, it is found by comparison of a large number of specifications by consumers that they agree in the main with the standard classification, and differ only in details arising from practice in various mills and foundries. Some of these differences relate to analysis and others to sizes.

Dealers serving these industries have no difficulty in keeping in mind the various individual requirements of customers and are able to fill the needs of clients without difficulty.

Taking up heavy melting steel, one of the largest items handled in the business, it is found that general agreement is found in all specifications. Pieces must be charging box size, to eliminate the expense of cutting or breaking to make them available. The limit in weight also is set to make handling easier.

The Illinois Steel Co. limits pieces for heavy melting steel to 6 feet in length and 20 inches in width and thickness, with no one piece weighing over 1000 pounds. It is provided that pieces weighing less than 5 pounds per lineal foot must be excluded, as well as those less than ¼-inch in thickness, dirty scrap, pieces not reasonably straight, cast malleable and busheling. No objection is made to agricultural scrap, No. 2 wrought and structural angles, channels and I-beams and rails free from cast joints. Pieces over 6 feet in length must be loaded separately from those under that size.

The Carnegie Steel Co. has similar requirements. The Brier Hill Steel Co. limits weights to a range of 10 to 300 pounds and excludes agricultural shapes, pipe, grate bars, brake shoes, cast iron, sheet or light stock. The Central Steel Co. limits its heavy melting steel to pieces of standard T rail, including frog, guard and switch points. The Colorado Fuel & Iron Co. has two divisions of heavy melting steel, railroad and agricultural. In the former are included drawheads, knuckles, couplers, springs, rails and steel shafting under 5 feet long and over 10 pounds in weight. Agricultural heavy steel includes plow beams and shares, axles, shafting and other heavy steel from agricultural machinery, no piece under 5 pounds. Rake teeth, sickle bars and other light material are rejected.

The Crucible Steel Co. of America limits size to 6 feet long, 24 inches wide or deep, but will accept pieces weighing up to 3 tons.

The Lackawanna Steel Co. provides for No. 1 selected heavy melting steel and No. 1 heavy melting steel, the former including heavier pieces than the latter.

Shoveling steel usually is used in connection with heavy melting steel in the open-hearth furnace and its name indicates its nature, pieces sufficiently small to be handled upon a shovel. It is placed in charging boxes with larger pieces and fills the spaces between them; also filling in the voids in the furnace when dumped. Most users accept much the same class of material in this item but some have special requirements.

The Brier Hill Steel Co. accepts railroad track scrap, consisting of spikes, bolts, nuts, boiler and bridge punchings, and clippings, small crop ends and bolt ends. They must be over ¼-inch in thickness and not over 12 inches in length or width. Light material is excluded.

The Inland Steel Co. under shoveling steel rejects malleable and cast iron, cut pipe and tank steel, skeleton stock, burnt material or cast or malleable attachments. The Pittsburgh Steel Co. will accept as shoveling steel, tie plates, blacksmith shop scrap, structural and boiler punchings, horseshoes and crop ends.

From these brief references to a few of the varying specifications put forth by individual consumers, it is seen that there is not much divergence from the standard. Matters of size are dictated by the capacity of the charging box in steel practice and weights are limited at the top by means at hand for handling the material; while the minimum weight and size is to prevent material being furnished which is so light as to give excessive oxidation in melting and consequent large loss in tonnage. Crooked pieces are excluded as they will not fit compactly in the charging box.

As practice is becoming more and more standardized

among steel makers and differences tend to disappear rather than to increase, it is a sign of the times that the tendency is toward simplification of scrap requirements, or rather to greater uniformity. Some of the special requirements set forth by buyers are so slight that they can be waived in cases of scarcity of scrap and insisted upon only in times when plenty of material is available. Under these circumstances, it is not difficult to see the day when they will be dropped and all scrap classifications merged into a uniform specification that will serve for all.

While most scrap users hew fairly closely to the standard specifications which suit the majority, there are occasional divergencies dictated by different equipment or other circumstances. In some cases these are fully necessary and in others they seem to have no real reason for existence and might as well be dropped, except that they have a precedent and have become a habit. As a rule the fewer restrictions are placed upon the dealer beyond the standard classification, the better service he is able to give. He naturally will sell first to the mill which does not have private and excessive requirements, since most of his scrap is bought upon the less particular basis.

Probably the specification of the Otis Steel Co., at Cleveland, on heavy melting steel is a joy to the scrap dealer and betokens a broad spirit. This states: "Specifications generally along the lines of other mills," and dictates only the size, not over 6 feet long and 18 inches wide.

On the other hand, the American Steel Foundries specifies that its heavy melting steel for the Sharon, Pa.,

plant must not be over 3½ feet long and 18 inches wide and for other plants not over 4 feet by 18 inches. Both these restrictions are because of charging box sizes and therefore necessary. Differences in practice lead this concern to specify that while low phosphorus scrap must be guaranteed below 0.04 in phosphorus and sulphur for general use, the Chester, Pa., plant requires it to be 0.035 or lower in these elements.

Use of a magnet rather than a shovel in handling scrap has brought in a new term and La Belle Iron Works, Steubenville, O., has a specification for "shoveling or magnet steel." Maybe the term magnet may supersede shoveling in the course of time. The same concern specifies in its heavy melting steel that it "must be straight enough not to tangle in handling with a magnet." Thus the new method is having its effect in dictating the form of the scrap to be handled.

Laclede Steel Co., St. Louis, has a specification for "No. 1 railroad steel," which seems almost like the standard specification for heavy melting steel, which probably will fill the bill.

The Midvale Steel & Ordnance Co. and its associated companies have a specification unlike others, for its valley and viaduct mills. This is called "forge fire," and consists of soft steel drop forge trimmings, bundled sheet scrap, cotton ties in bundles, skeleton scrap in coils like belting, all free from tinned, painted and galvanized material, malleable, copper, brass and other metals and suitable for use in forge fires. Doubtless much of this specification is formulated to cover special sources of supply from its immediate market.

The Montour Rolling Mill at Danville, Pa., specifies that its No. 1 cast must be broken to "one-man size," though what might be one man's size might be too much of a lift for another man. The National Enameling & Stamping Co., St. Louis, specifies that all cars must be swept clean before loading.

The Rockaway Rolling Mill at Rockaway, N. J., specifies "long New York City wrought" scrap, which is purely a local classification.

Many specifications for No. 1 wrought include railroad links and pins. These are excellent material but this specification is growing obsolete since the automatic coupler has come into such universal use and links and pins have been discarded.

The St. Louis Screw Co., St. Louis, and the Texas Rolling Mill Co. have a classification known as "No. 1 mill" and "No. 2 Mill," which seem to be peculiar to the southwest. They resemble busheling but it is required that carbon be below 0.12. The Youngstown Sheet & Tube Co. requires that all bridge scrap be wrought iron and that compressed scrap must weigh at least 75 pounds to the cubic foot.

Convenience in handling scrap at the consumer's yard dictates to a great degree the way in which it should be loaded. For the most part consumers specify that open cars or gondola cars be used. This is because magnets are used to such a large extent in unloading scrap and it is impossible to use a magnet on a box car or a cattle car.

During the shortage of cars of open type, when the demand was heavy for them to transport coal, railroads refused to furnish them for scrap loading and it was nec-

essary to load a great deal in box cars and even cattle cars. Under these circumstances mills were forced to accept their material in spite of their specification. This imposed an added expense on the seller and the buyer as it costs much more to load and unload when closed cars are used.

Not only is it demanded that open cars be used but the manner of loading also is dictated in many cases. Thus one steel company provides that shear stock must be loaded on cars separate from the same grade in chargeable shape. Other consumers demand that in loading melting steel all fine material must be loaded in one end of the car. Many specifications provide that no mixture of grades must be made and that only one kind of scrap must be loaded in a car.

Exception usually is made to the requirements for gondolas, in that long steel rails may be loaded on flat cars, the reason being obvious. Some mills specify that the gondolas must be flat bottomed, evidently to prevent the use of the hopperbottom car which would not be convenient in unloading.

Some buyers provide that short scrap and shoveling steel may be loaded in the same car, but that the shoveling steel must be at one end or in the bottom of the car.

Ease in removing the material is the cause of these restrictions and it is provided in many cases that twisted and tangled scrap must not be shipped. In using the magnet on a load of this class of scrap it is almost impossible to lift it clear and it is a hard matter to get the material out.

One company distinguishes between heavy melting steel under 6 feet in length and that over 6 feet, requiring loading in separate cars. The longer scrap must be sheared to charging box size and the car containing it thus would be sent to the scrap preparing yard instead of to the point where material ready for use is unloaded.

Steel rails, frogs, switches and guards also are required to be loaded separately from other heavy steel, except rails under 5 feet, which may be mixed with other heavy steel.

Dealers are careful to conform to these requirements in loading scrap as improper loading usually leads to rejection by the consumer and it is easier to use care in the first place than to try to rectify the matter after rejection. Inasmuch as there is good reason for these requirements, in that the cost of unloading is increased by improper loading it is justifiable to ask a concession in price as a consideration for accepting it in poor shape.

Under circumstances existing in times of car shortage the open car is likely to be lacking at a time when box cars are available and the latter can be furnished more easily. In such instances it usually is possible to arrange with the buyer to take the scrap in a box car, depending on how great his need for it.

CHAPTER V

Chemistry Enlarged Scrap Use

One of the important industries using scrap in its mixture is the gray iron and malleable foundry. In the earlier days of founding, not much scrap was used and pig iron of a grade determined by fracture was relied upon to get exact results. Some small percentage of scrap, mostly produced in the foundry itself, was about the extent of this use.

When chemistry came to the aid of metallurgical operation, the situation was changed, and it was found that scrap could be used in considerable proportion. Now it is common practice to use 50 per cent of scrap in foundry mixtures, and 80 per cent is not uncommon. Steel scrap formerly was not even considered for foundry use, but now is generally given a place without bad effect.

The extent to which scrap was avoided in the older days is indicated by the fact that some superintendents were so particular about their mixtures that they would not allow nails or metal objects to remain attached to the kindling used in the cupola. From that state to the present free use of scrap is a long step in progress. This advance has been made in the face of handicaps, as a suitable classification has not been available to guide the foundryman in his choice of scrap. He has bought much in the dark as to scrap, though his other materials have been well analyzed and he has known what he bought.

SCRAP METALS

Even now many foundrymen have no definite ideas as to what they need to get certain results and they rely upon experience almost entirely in buying their scrap. This condition has been recognized by the American Foundrymen's association and the first effort to form a scientific classification was originated by this organization.

In getting an expression from members as to the proper basis upon which to build its classification, the committee received a valuable suggestion from a Philadelphia foundryman. He wrote, as set forth in the report of the committee to the association:

"In classifying scrap our thought would be to grade it with reference to the amount of silicon (and other elements) it is likely to contain."

On careful analysis the committee came to the conclusion that such a result could be reached by arranging the sub-classifications according to section rather than the weight of the piece. Foundry practice is so standardized that castings of similar section made for the same general purpose, have a common, definite chemical composition, within reasonable limits.

It is assumed with good grounds that light machinery sections of ½-inch or less contain 2.25 to 2.75 per cent silicon, 0.08 to 0.10 per cent sulphur, 0.65 to 0.75 per cent phosphorus, 0.40 to 0.70 per cent manganese and 3.25 to 3.35 per cent total carbon. Heavier sections contain less silicon. It is agreed that analyses assumed from the metal sections will be found sufficiently accurate for practice in figuring mixtures.

Malleable practice also is sufficiently uniform to allow classification on a basis of metal sections. Steel speci-

fications which have proven satisfactory in the main have been in use for several years, but steel foundrymen differ somewhat and the committee proceeded to include steel in its revision, on the same basis of metal section.

This classification will be found in full in the appendix. Changes in relations of various grades of iron and steel scrap have taken place since this industry began to assume importance and as a result some specifications still in use have become archaic.

For instance, some mills provide that steel scrap shall be free from wrought scrap. When steel was a more costly material than iron, this doubtless was necessary to prevent the steel being diluted with less valuable material, which would not fit well with the analysis desired. But in more recent years steel has become less valuable compared with wrought iron and although the specification still forbids this mixture, it is not likely that a dealer will knowingly allow the more valuable scrap to be sent out with the steel. The tendency would be more likely toward allowing steel to be mixed with the wrought scrap, which commands a higher price.

Since cast scrap is not different from pig iron in its characteristics and is used in place of pig iron in open-hearth practice, along with steel scrap, it would seem unnecessary to prevent mixing these grades. Yet they are kept separate and for a good reason. In figuring the proportion of steel and of iron, in his mixture, the melter must know how much of each he can charge to get the required analysis. If the cast iron was mixed with the steel in an unknown proportion, he could not know how

much carbon or other elements might be present, and his steel would be of an uncertain quality.

For this reason it is necessary that the two be handled separately to give the proper proportions in the metal charged. As a matter of fact, few cars of heavy melting or shoveling steel used by a steel mill are entirely free from a small proportion of cheaper grades. It is practically impossible to prevent some mixture and some dealers figure on getting a small percentage of cheaper scrap into each car of steel, making a large profit in proportion by this practice. To detect this small mixture of cheaper grades is nearly impossible, and as a matter of fact it really does no harm to the steel. When the proportion runs to a noticeable degree, rejections follow.

Practice at steel mills does not give opportunity for sorting out scrap as carefully as can be done by makers of wrought iron. In the former case the tonnage is larger and the scrap is handled rapidly and in masses, while in making fagots for wrought iron almost every individual piece is handled and poor qualities can be thrown out.

In making bar or wrought iron, steel scrap is not desirable as it will not weld with the remainder of the scrap, the hard steel lacking the qualities necessary for this result.

In steel mills having their own blast furnaces, direct iron is most advantageously used for the iron content of the mixture since it is already liquid and the steel scrap charged with it melts readily. Open-hearth furnaces using cold pig iron can make use of cast scrap in place of the latter since cold metal must be melted in the furnace in either case. Thus the availability of pig iron dictates

to some extent the use of cast scrap in the open hearth. Some melters use practically all scrap at times and get away from pig iron entirely, the quality of the steel remaining the same with careful practice to get the proper mixture of iron and steel and hold carbon, sulphur and phosphorus sufficiently low.

CHAPTER VI

Railroad Scrap Handling

Inasmuch as railroads are the largest users of iron and steel and furnish the largest portion of scrap as the material wears out, the greatest opportunity for careful sorting and reclaiming is found in the railroad scrap yard. Further, as the railroad accumulation of scrap consists of manufactured articles instead of simple waste from some manufacturing operation, its component parts offer large opportunity for careful judgment as to the possibility of further use by slight betterment.

Former practice, in the heyday of the railroad, when materials were cheap and costs were not watched closely, was to load up everything that seemed to have passed its usefulness and offer it on the market as scrap. The judgment of hundreds of employes, most of them possessing little skill, was relied upon in scrapping material. The result was that much was sold as scrap that had a high value for further use.

The first step toward better things was brought about by establishing yards where the scrap was collected and sorted in accordance with the classification, thus obtaining the advantage of better prices than mixed scrap could command.

From that first gain to the present refinement obtained in the practice of some careful railroads, progress has been steady and gradual until it seems that little room for further improvement remains.

RAILROAD SCRAP HANDLING

Broadly speaking, three processes are applicable to the accumulation of railroad scrap. It may be scrapped, reclaimed or utilized in some other way. In addition to these three dispositions, careful inspection brings to light every case where material has failed through defect or before the period of guarantee has expired and gives opportunity for claim for replacement or credit on new material, based on the unexpired guarantee period. Additionally, the refinement in close inspection results in more careful classification of the scrap remaining, which is sold as such, thus eliminating trouble with the purchaser of the scrap, usually a dealer, who meets rejection of the shipment when he has sold it under the supposition it was fully in accord with its proper classification. Such rejections usually result in a loss of $2 to $5 a ton. In the experience of one large railroad system using a careful system, no such complaint has been received in several years and the saving in this one negative way is sufficient to pay for the transportation back to other points on the line, of all the serviceable material reclaimed.

Roads with well developed systems for handling scrap material are profiting largely at present and are able to take advantage of the present high level of the market. In 1911 one railroad sold its scrap material, the residue left after careful selection and winnowing, for an average of $7 a ton. In 1916 the average realized was $14 a ton and during 1917 it received an average of over $26 a ton.

On the reclaimed material the profits were in greater proportion, especially in view of its affording an immediate supply in times when new material is impossible to

obtain promptly. Labor costs have increased in proportion to prices of material but the margin of profit in the scrap department is still large and if convenience could be estimated in cash it would be even larger.

The experience of the Atchison, Topeka & Santa Fe railroad, one of the largest systems in the country, extending from Chicago to the Pacific coast, is of interest. The system worked out by this road through a period of several years has resulted in establishment of a classification and reclamation plant at Corwith, a suburb of Chicago, which is believed to be the largest and most complete in the world. Certainly no other in this country excels it in effectiveness.

Before taking up the careful handling of its scrap, the Santa Fe railroad maintained a number of central collection points on its great system where scrap was sorted to some extent and shipped to Chicago, the nearest large consuming point, and there sold in the market. The sorting depended largely upon the judgment of section men and was subject to little expert supervision. Almost no attention was given to working over or saving serviceable material. It was easier to throw anything temporarily out of useful condition into the scrap heap and use a new article in its place.

As the Santa Fe pursued a policy of keeping its properties in the highest possible condition, the proportion of useful material in its scrap accumulations was high and came to the attention of officials. The result was that careful inspection was made of several cars and it was found that 60 per cent was serviceable and much of the remainder could be made useful by small repairs.

This condition gave rise to the present plant at Corwith, though its development has gone much further than was planned at its inception. At first it was little more than a central point for the collection and classification of scrap where expert knowledge could be applied to sifting out the usable elements and making small repairs. At present it is a manufacturing plant in addition to its original purpose.

It occupies 25 acres and has a number of large buildings and various classification yards and platforms. Employes number about 650, some of whom are unskilled, while others are high class mechanics, blacksmiths, tinsmiths, machinists and ironworkers. Women have been employed in the tinshop on light work with satisfactory results.

The annual volume of scrap handled in the Corwith yard since 1911 has been 140,000 tons. Figures compiled by the Santa Fe are of interest as indicating the importance of this work. In 1911 approximately $1,000,000 was realized from 143,000 tons of scrap, about $7 a ton. The cost of handling this tonnage was about $50,000. In 1916 about the same tonnage was sold at $2,000,000 and the cost was $103,000 for handling. In the first three quarters of 1917 more than 120,000 tons were sold for more than $3,000,000, an average of $26 a ton, and the cost of handling was $162,000.

Reclaiming gives large profits and since 1911 the value of the reclaimed material has never been less than $1,000,000 per annum and in some years it has exceeded that figure by several hundred thousand dollars. The saving effected by reclaiming has varied from $300,000

to $500,000 a year. Figures show that in 1916 reclaimed material was valued at $1,105,000 and the saving was $318,000. In 1917 the first nine months gave a total reclaimed value of $1,048,000 at a saving of $315,000. The saving is the difference between the cost of the material if bought new and the cost of reclamation.

As a result of the care exercised at Corwith, the proportion of serviceable material loaded as scrap along the line has been reduced from 60 per cent to 8 per cent. This proves that users of material on the railroad and in its shops are getting greater use out of material than before, with a corresponding saving that cannot be estimated accurately. This is an item that is known to exist, but cannot be put on the books.

Another saving comes about through replacements of defective material by its manufacturers. It has operated in the case of the Santa Fe in a smaller percentage of poor quality being furnished by manufacturers, who are aware of the close inspection. Defective material arriving in scrap shipments is laid aside and the manufacturer notified. Once in three months an inspection is held and this reserved material is gone over and replaced. In one such inspection some years ago 24 engine cylinders, 1500 freight coupler knuckles and a large quantity of couplers, bolsters and side frames were replaced. In one month 200 air hose were replaced. The result of this system is to reduce largely through the past few years the quantity of defective material found, indicating a better quality furnished. Manufacturers replace the material or give an allowance for the scrap value. In the case of guaranteed articles allowances for the unexpired

term of the guarantee period are arranged. Usually these materials then are sold as scrap by the railroad.

Even the work of collecting scrap from thousands of miles of line and many shops has been improved and expense eliminated by the Santa Fe railroad. This has been placed in charge of the stores department. Once it cost almost as much as distributing new material. Formerly the scrap was shipped in small lots from section headquarters, yards and shops, each shipment partially filling a car and thus using an undue quantity of equipment. Under the new plan the supply train that distributes material along the line picks up the scrap at the same time.

The supply train makes its rounds once a month. A section gang is picked up to load the scrap and thus other section crews are not interfered with. The crew loading the scrap also is more expert and gives better service than the average track workers. Full cars are dispatched at once to Corwith. Foreign line cars which must be returned to the Chicago terminal to be turned over to their owners are used in this service as they must be hauled east empty otherwise. This relieves the demand on rolling stock to handle scrap.

Local storekeepers inspect the accumulation before shipment to detect usable material that can be removed and utilized. Defective material is marked by the storekeeper to call attention to the defect at Corwith, giving a double check. On arrival at Corwith, the scrap first is weighed and given a superficial inspection in the car to note serviceable material on top of the load, to remove it to prevent possible damage in handling with a magnet

and dropping it or in dropping heavy material on it. The car then is directed to the unloading yard and emptied by a locomotive crane. Four of these are in service, three equipped with magnets and one with a chain.

Once unloaded, the scrap is attacked by the sorters and classified. This is one of the most important operations in the series for a number of reasons. If properly done, it picks out all material more valuable than mere scrap and places the latter in its proper bins so that shipments meet specifications and prevent rejection from the presence of improper material in a given lot.

Sorting is done by unskilled labor under the direction of three experts who are held responsible for the results. But even the unskilled labor requires a certain degree of intelligence as there are nearly 100 classifications into which the material must be divided. Even unskilled labor becomes somewhat skilled in handling the accumulation as experience in a short time shows exactly where the great majority of the pieces should be disposed.

The Railways Storekeepers' classification is followed, as this is almost standard and fits well into most cases. It is explicit and the result of long experience and desires of consumers, and for that reason makes the selling easier since the scrap under this classification is of perfectly known makeup and quality.

When the actual scrap has been picked out and classified at the Santa Fe plant at Corwith, there remains material which can be used without repair, some that can be rendered fit by small repair work, material for inspection and replacement by manufacturers because of defects,

and other material which is to be worked over into new products.

A number of large buildings house the departments devoted to repair and conversion. Being a reclamation project, it has been the policy of the railroad to utilize old material in the construction and equipment of the buildings. Comparatively little new material has been used for this purpose. Sufficient scrap timber, iron and steel has been found in the accumulations sent in to erect the structures almost entirely. It should not be gathered from this that the Corwith plant looks like "Shantytown," for such is not the case, the buildings comparing favorably in appearance with others used for the same purpose, while the material as a rule is of superior quality.

About 40 per cent of the machines in use at the plant were recovered from the scrap, repaired and placed in service. Other serviceable machinery is being recovered constantly. Belt pulleys practically all came from this source. Recently a 12-inch pipe threader was recovered and repaired, at a saving of over $3000 under the cost of a new machine.

Shop No. 1, to use the yard designation, is 40 x 365 feet and well equipped. It contains two small rolling mills, eight bolt headers, 13 threading machines, two bolt shears, one splitting shear, four trip hammers, three nut tappers, a brakebeam testing machine and a blacksmith department with 20 forges.

Shop No. 2 is 46 x 150 feet and is devoted to wheel and machine work. It has for equipment five boring mills, a wheel press, two axle lathes, a wheel lathe, two automatic bolt machines, four drill presses, two jumpers,

a milling machine, two planers and numerous small machines.

The valve and air brake shop has suitable machinery, including grinders and testing racks, for reseating valves.

The rolling mill is a recent addition and was constructed almost entirely from old material, old structural steel, bridge iron and bridge timbers being used. Much of the lumber was from the Santa Fe's exhibit at the Panama-Pacific exposition at San Francisco. A standard 12-inch rolling mill and two 4-door furnaces now are in operation, with sufficient rolls for the sections in demand. A 9-inch rolling mill is under construction.

The powerhouse is 70 x 70 feet and 30 feet high. It contains three 300-horsepower boilers and an 1800-cubic foot air compressor. There is also an oxyacetylene welding plant and a sheet metal shop.

In these and the smaller shops the entire range of repair and new manufacturing operations is carried on. As new possibilities present themselves new lines are added and the plant is constantly growing in its breadth of service. Ideas are stimulated and the effort is being made constantly to devise new lines along which material otherwise wasted may be conserved and returned to efficiency in its old form or in some new form, with the result that the residue of real scrap, material for which no use is found and must be sold, is showing a relative decrease to the tonnage carried to Corwith. Utilization is being carried so far as efficiency will allow and all to the benefit of the financial condition of the road.

In the various shops many interesting processes are carried on in restoring old material to valuable form. The

rolling mills receive all the iron that can be rolled and it is converted into merchantable iron for making bolts and filling shop requisitions. The bolts are made in the same shop. In the first nine months of 1917 almost 3,000,000 machine and carriage bolts, 50,000 drift bolts and 2700 kegs of tapping nuts were reclaimed at a saving in excess of $86,000. The scrap value of the material used, labor and shop expense were counted as the cost and the difference between that and the cost of the bolts were they bought new is the saving.

Wheel and machine work is under the supervision of experienced technical men. Tires are removed from steel wheels which have become worn and new tires fitted, making practically new wheels. Formerly it was necessary to forward these wheels to the manufacturer and pay for transportation, labor and new material. In the first 14 months of the wheel shop's operation the saving was $60,000.

Turning of axles gives a large saving and returns to service a large number of axles that formerly went into the scrap sold. In nine months of 1917 passenger axles numbering 100 and freight axles numbering 461 were turned and the saving was $5500. In the same time various wrought iron forgings were made at a saving of $9000.

Careful attention to airbrake hose and valves in nine months of 1917 resulted in the repair and return to service of almost 3000 articles, at a saving of more than $3000. The hose is inspected carefully and whenever serviceable it is refitted and returned to use. Saving on this item alone has run close to $30,000 a year.

SCRAP METALS

Bar iron from the rolling mill in the first nine months of 1917 totaled a trifle over 4,000,000 pounds, costing $122,000. The cost of this tonnage of new iron would have been $200,000, giving a saving of more than $78,000.

The oxyacetylene welding plant is a new feature, and gives some fine results. In the first three quarters of 1917 repairs were made on 145 side frames, 128 truck frames, and 14 bolsters. The total saving of the welding department is over $5000 for this period.

The sheet metal shop probably is the most remarkable development at Corwith. Through its operation the Santa Fe has ceased to buy many types of buckets, oil cans, oilers and pots. Much of the supply of funnels, drinking cups, strainers, sprinklers and other containers used on the system are manufactured in the sheet metal shop. The principal source of raw material is galvanized sheets from car roofs. This material possesses little value as scrap but it is converted into the articles enumerated and gives better workmanship and superior material to the same articles ordinarily purchased in the market. In the first nine months of 1917 several thousand oil cans of various types, thousands of sheet metal specialties, 1879 boiler compound cans, 1638 mixing buckets, 1026 slush buckets, 1386 tallow pots and 2261 buckets were turned out, at a large saving over their cost if bought new.

More than 200 separate kinds of articles were repaired in 1917, some in large numbers. As examples, nearly 5000 angle cocks, over 5000 brake beams, 5000 track shovels, nearly 10,000 tamping picks, 5600 knuckle locks, 10,000 knuckle pins and 2000 kegs of washers were turned

out. The latter are made largely from boiler tubes and flues rolled flat, two washers being stamped out at each punch.

About 35 carloads of reclaimed material are distributed from Corwith each month, being sent out and treated the same as new material, no difference being made in storehouses between the two. In fact some of the reclaimed material is considered superior to the new.

Although the accounting method employed by the Santa Fe railroad in connection with its reclamation ma not be strictly related to the scrap industry, it is of interv est as a guide to the accuracy of the results claimed by the railroad.

The actual cost of repair or manufacture includes the sale value as scrap of the material used, labor, shop expense, and supervision. The material is charged out at the price it would bring at the time, labor represents the actual labor cost involved and shop expense and supervision are proportionate. This total cost is deducted from the value of the article as new, the difference being the saving.

When the cost exceeds the value of the article, the difference is carried in red figures. Two months in red figures usually results in discontinuance of the repair or manufacture. This is not always true, for there are other considerations. It may be that the material and workmanship of the repaired or manufactured article is superior to what can be bought, as is the case in the sheet metal articles. They will wear longer and give better service.

Additionally, availability of new articles must be considered. In the present condition of the market it is

almost impossible to obtain some classes of goods without considerable delay and in some cases they are unobtainable. It follows that reclaimed or manufactured articles from the Corwith shops thus have a real value that will overcome some slight excess in the computed cost of returning them to service. This is a guide to modify the rule of abandoning a reclamation item when the cost is larger than the figured saving.

One effect of the careful attention to scrap on the Santa Fe lines is a closer collection of used material, which keeps yards and shops clear of accumulations. Every division is credited with the material turned in and nothing is allowed to be thrown away if it possesses any value. Thus the available metal is all collected and turned in to sweep the tonnage from the division and make the best possible showing in the credit. Trackmen collect every bolt and spike along the right of way and scrap at the shops is cleared thoroughly and forwarded to Corwith.

One exception to the rule of sending everything to Corwith is found in the case of steel rails. The company for many years has maintained a rerolling mill at Newton, Kansas, where rail sections are reduced. The rule is for all rail from points west of Newton to be shipped there, where it is sorted and the rail suitable for rerolling is so treated, short rail and those worn too much to be rerolled being sent to Corwith for sale as scrap.

From points east of Newton where shipment to that point would involve a double haul, the entire shipment of rail is forwarded to Corwith.

A building 40 x 150 feet is devoted to the handling of all brass scrap, which is specialized. It is equipped

with melting pots, a washing machine and a magnetic separator. This shop makes a saving in broaching journals, boring journals for relining, reclaiming castings and separating iron from borings. Brass cinders and sweepings also are washed. Formerly all journals were scrapped without attempt to broach and reline them. Borings were sold mixed with iron while cinders and sweepings were dumped.

One washing brought 56,000 pounds of metal selling at 5.5 cents a pound, and 22,000 pounds of mud selling at $3.75 per ton. Both these savings gave a fine profit over the cost of the treatment.

CHAPTER VII

Some Short Cuts

Not all scrap gathered by railroads and consumed by steel and iron manufacturers passes through market channels. Ordinarily railroad scrap is offered in lists showing the tonnage of various grades and bids are made by dealers, who serve it in turn to their customers. This is more convenient than it would be were railroads to conduct the business of selling to the actual consumer.

But circumstances sometimes make it advisable to deal directly, and in the aggregate this takes a large tonnage of scrap out of usual channels and diverts it directly to the user.

This is done in what are known as "conversion agreements." The railroad furnishes tonnage of scrap in return for tonnage of some form of iron or steel supplies, paying an agreed differential, to cover the cost of conversion from scrap to the finished article. In this sort of a transaction the prices of the scrap and of the finished material have no weight as the differential covers the transaction whether market quotations are high or low.

Some railroads obtain practically all their new wheels, bar iron and tie plates in this way. When scrap is scarce in the market and prices are out of line the manufacturer has an advantage in getting his raw material promptly and certainly, and the railroad is on a better basis to get its order filled promptly.

This custom has been enlarged recently and a wider range of grades of scrap is being furnished by railroads on these conversion contracts. This may be one factor in the apparent shortage of scrap on the market. However, the apparent shortage resulting from this diversion of tonnage is not real as the consumer obtains his material and thus is not a buyer, to that degree reducing demand on the tonnage that does flow in regular channels.

Some mills and manufacturers do not take kindly to these agreements because of the peculiar effect they sometimes have upon cost sheets and financial statements. Thus a car-wheel maker may credit scrap received from a customer when the market is at a certain level and may deliver wheels when the market is higher, a book-keeping discrepancy thus appearing which does not look well, though there is, in reality, no loss in the transaction.

Another method of making scrap accumulations serve a useful purpose is illustrated by a recent trade deal. An automobile builder had a tonnage of shoveling scrap which he desired to market. He was meeting difficulty in obtaining material for his own processes and by negotiation made a conversion agreement by which he obtained material from mill at once in return for his scrap. He paid the regular price but let his scrap go at a concession from the existing market, making a price close to the average of scrap in the mill yard. He considered the receipt of prompt material was worth more to him than the difference in price received for the scrap. Under other circumstances he would have had to wait for his new material a number of weeks.

Getting all the profits possible and assuring itself of a certain source of supply for most of its bar iron, the Great Northern railroad maintains a bar iron mill at St. Cloud, Minn.

No better instance of utilizing the scrap to the best possible end is presented and the success of the experiment has long since been demonstrated. Aside from the financial savings accruing from controlling the entire process from scrap to finished product for its own use, the railroad is sure of its quality and can obtain material at once for any use for which it is demanded on short notice without awaiting the convenience of a commercial mill.

The St. Could plant is equipped with a standard 12-inch mill with three sections, i. e. roughing, stranding and finishing. The scrap is sheared, and piles of 75 to 150 pounds are made. The output is about 450 net tons a month, of a varied assortment of sizes.

From this output the road makes common bolts, carriage bolts, and all rivets used on the entire system except those employed exclusively on locomotive boilers.

The St. Cloud mill has rolls to produce all the sections the railroad needs. In rounds it makes practically all sizes from ½-inch to 1⅛-inch. In flats the variety is wider, ranging from ¼ x 2 inches to 1 x 4 inches, 50 flat sections being provided for.

Squares are rolled ½, ⅝, ¾, ⅞, 1-inch, 1⅛, 1¼, 1⅜, and 1½ inches. Hexagon sections include ⅛, 1-inch, 1⅛, 1¼, 1⅜, and 1¼ inches.

The same railroad has another mill at St. Paul, Minn., where heavy bar iron is produced. This mill is equipped to make sections from 3 x 3 inches to 12 x 12 inches,

with all sizes intermediate, such as 3 x 6 inches, 6 x 8 inches, 8 x 10 inches and 10 x 12 inches.

The heating equipment at the St. Cloud shops consists of two oil furnaces of sufficient capacity to handle the fagots up to the largest the company needs.

The equipment of these mills is complete and the scrap yards where the material is prepared for the bar mills contain shears and other equipment for the economical handling of scrap to fit it for the furnace.

Much reclaiming also is done by this railroad to make available material that otherwise would be valuable only for scrap. This is returned to the shops for reuse and replaces new material at a low cost.

Ingenuity has been found a useful outlet for some forms of scrap material that formerly were only waste and went back to be melted. Now these materials are utilized in further manufacturing processes instead of being discarded and sold. This gives a larger return to the owner of the material and to an equal degree lessens the demand for new material for the purpose to which it is applied.

Numerous instances of this sort exist and in each case a decided saving is made over the former practice of regarding it as scrap. A western railroad for some years has utilized its old flues in making washers, the process being carried so far that practically its entire washer supply for track and car work is produced from this source. Engine flues are made from a high grade of material and after they have lost their value as flues, they are susceptible of being transformed into washers of fine quality.

The flues are run through rollers and flattened, giving a double thickness of material several inches wide. It is then placed in a punch press and washers are produced, each punch giving two washers, one from each layer of tube material.

Other roads sell the flues as scrap and they are cut into lengths required by the consumer's specifications and become shoveling or busheling scrap.

In rolling steel plates, the ends press out into an irregular form, called horns, which must be sheared off to make the plates square. On wide plates these horns are sufficiently large to allow a triangular piece to be sheared which is used by fabricators as a gusset in strengthening the angle where structural members are joined. The sale of these plate horns gives the fabricator a less costly material for his gussets, as good as though cut from full plates. The seller realizes more from the material than would be the case were it sold for scrap.

In the manufacture of automobiles, irregularly shaped pieces of light plates and heavy sheets result from cutting material for bodies and other parts. Formerly these were regarded as scrap and sold for that purpose. More recently they have been utilized in the manufacture of washers and a thriving business is being done in reclaiming this material from the scrap dealer.

Trimmings of sheet steel and tin plate left from various manufacturing processes have been utilized in making bottle caps and parts for metal toys, at a saving of material and of expense. Recently Japanese exporters have been cutting tops and bottoms from oil cans formerly thrown away after being emptied. The resulting sheets

of tin plate have been bundled and shipped to Japan to make up in part for the shortage in this material.

In all these processes there remains a scrap residue, of small proportion to the original mass, the difference having gone into finished material of much greater value. Costs of transferring it and the operation of converting it are well within the sum represented by the difference in its scrap and finished values.

CHAPTER VIII

Scrapping of Entire Railroads

High prices for scrap have had some unexpected and unusual effects on railroads, and the results will be felt for years to come in some degree. Unusually high prices have had the effect of tempting railroads to collect and market as much of this material as possible, to obtain the largest returns, especially in view of the higher price paid for new material.

This has been done by all roads which could obtain sufficient labor, and as a result present offerings are smaller than usual, as the reserve has been marketed in the past and is not now available in the normal volume. This is one factor bringing about the shortage of scrap which has been a feature during the war.

An instance of this can be cited. Railroads ordinarily retain second-hand rail taken from main lines, when in good condition, and relay it on branch lines and side tracks where traffic is lighter and demands less exacting. The rails and fastenings on the secondary lines usually are too light and too much worn for further use under heavy equipment and are sold as scrap.

Under present prices railroads which were able to command labor and obtain new track fastenings have expedited the relaying of branch lines and have released the old rails and accessories a year or two years earlier than would have been the case under normal conditions. The lack of this material was felt the next year, while

its presence in the supply during the heavy demand for scrap was not particularly noted.

This process has shown a handsome profit to the railroads, one company figuring a gain of $1000 a mile after deducting all labor and other direct charges. The high price of the scrap made this possible, the relaid rail being charged out at the price at which it was being carried on the books.

Another effect of unusually high prices has been the entire dismantling of some short railroads which were bankrupt and not earning their expenses. In some cases courts have allowed the roads to be sold for scrap and abandoned as railroads, the process giving a profit to the buyer and relieving the owners of a source of expense. The process has had the effect also of increasing the tonnage of scrap at a time when it was vitally needed.

Many small branch lines, parts of larger systems, are constant drains on the paying portion of the property, and it seems likely some of these also may find their way to the scrap pile.

Recently a prominent scrap dealer bought a short road in Indiana at receiver's sale and started to dismantle it for salvage. Residents along the line sought court action to prevent the abandonment of the road, but the court refused to interfere, as the line had been in the hands of the court for nine years and never had paid a profit.

The same dealer has made something of a specialty of this sort of buying and has "junked" more than one short railroad which he has bought through receivers. In one case part of the equipment was sold for export

for war use and the remainder came into the scrap market.

In the present great need for large tonnages of material to eke out the shortage in pig iron, this is a distinct gain and an aid to the country in keeping up its steel production.

Statistics gathered from railroad sources indicate that the year 1917 saw, for the first time since railroads have been built, a voluntary abandonment and dismantling of any considerable mileage.

Carefully gathered figures show that known cases aggregate 450 miles of track actually torn up and sold or in process of being torn up. In addition to this, permission had been asked of state commissioners and legislatures for tearing up 400 miles more and operation had been discontinued on a trifle less than 500 miles where business had been unprofitable, and which may be torn up later.

This is a total of more than 1300 miles of railroad put out of service. This is believed to be in excess of new road constructed in 1917 and is the first instance where abandonment and scrapping of railroad mileage has reached a point where a record has been made. Previously logging and mining roads along whose lines the timber or ore had been exhausted, furnished the only occasions for dismantling. In the cases met in 1917 to a great degree, these causes have not been operative but the lines were a losing proposition.

High prices for the material, rails, scrap and rolling stock, have had much to do with the sudden decision

to go out of business as it gave a better return to stockholders than had been possible before.

Not all the rails and other metal property of these roads has come into the scrap market, as much of it has been sold to other railroads and is in active service. But the salvaging of the roads has been done largely by scrap dealers who have sold what was of high value for continued use and have sorted and marketed the rest as scrap at high prices. In some instances the roads were torn up and exported as far as they were of value, to assist in prosecuting the war.

With almost 800 miles of road abandoned as far as use is concerned and 300 miles of this seeking permission to sell for scrap, the available material from abandoned railroad projects seems likely to assume a large tonnage in 1918. State bodies in control of railroads in the past have been chary of giving permission to owners to tear up tracks and sell the materials, but such representations have been made in the present instance to reverse this practice and allow permission.

No one section of the country has predominated in this movement and north, south, east, west and the intermediate sections have all had their examples of the tendency to do away with lines that are not situated where they can be made successful and pay a return on the investment. In some instances roads had tried for 25 years to obtain sufficient business to bring a return and gave up when it appeared an impossible task.

Doubtless this source of scrap supply has done much to alleviate the shortage which had been felt and had this mileage not been torn up and part of the metal made avail-

able as scrap the shortage might have been much more acute than has been the case.

Iron rails form an important item of scrap dealing and at present command a high price from users of pure iron. This form of scrap is becoming scarce as iron rails are not being rolled now, having been replaced entirely by steel. In fact, it has been so long since iron rails were last made in any important tonnage that it would seem that they would have disappeared before this time.

The last year when any important tonnage of iron rails was rolled was 1902 when 6512 tons were produced. Since that time until 1911, about nine years, the total iron rails rolled has been 3331 tons. No iron rails have been rolled since the latter date.

Yet through all the years since 1902 iron rails have been an article of commerce among scrap dealers and users, and the supply even yet is not exhausted. A surprising tonnage comes out through the year, although each year it would seem that there must be an end to the supply.

Buyers of steel rails for rerolling constantly find iron rails mixed in their purchases. They are readily recognized and are set aside for resale to users of iron. One rerolling mill sorts out about a carload a month from this source and sets them on the right road to their proper destination.

The old iron rails appear to be lingering in switch tracks and sidings on which no repairs have been made for years, and thus they come out from time to time as these tracks are torn out or must be repaired. Sometimes iron rails with steel treads are found, this form having been rolled for a time to provide a better wearing sur-

face than the iron afforded. These rails are not as desirable as straight iron or steel rails.

Bar iron mills value iron rails highly as they present pure iron in comparatively large pieces which can be included in the heating furnace piles and assist in producing a high grade of wrought iron. They are cut to lengths and sometimes are slit through the web to allow closer piling than the entire section of the rail would allow.

Disappearance of this form of iron from the market marks the last chapter in the interesting history of the once flourishing early railroad rail which was one of the biggest features of the early iron and steel business of the country and probably did much to bring about the growth of the industry before steel began to forge to the front.

It is easy to foresee the day when a carload of iron rails will be a curiosity and when they will disappear from scrap list entirely as not of sufficient importance to be handled.

CHAPER IX

Scrap Yard Practice

It is timely at this point to discuss the operation of scrap yards where sorting is done to separate the several grades as received from those who gather and sell the mixed scrap which requires assorting and grading. As has been stated previously, railroads usually offer their old material ready for the consumer, classifying it in their own yards. This is not true of all railroads, as some sell carloads of mixed material which must be worked over before being offered. The procedure in the railroad sorting yard is much the same as followed in the dealer's yard.

The dealer's scrap yard operates principally on two classes of mixed scrap, dealer's mixed, known to the trade as "country mixed" iron, and railroad mixed scrap. The former is a conglomerate mass of junk such as accumulates in any scrap yard from various sources of supply, households, factories and farms. This usually is collected by the peddler commonly known to the city folk as the "junk-man," with whom most of us have had experience of sharp financing in our younger days. Indeed, it is to the junkman of our youth that not a few of us undoubtedly must give credit for our first fundamentals of close business transactions.

Households supply no small part of the daily collection. This includes old cook stoves, coal heaters, gas ranges, furnaces, radiators, flat irons, plumbing discards, washing

machines and tubs, with other articles too numerous to mention.

The small factory furnishes a ton or two a week, and the farmer his quota of abandoned or obsolete implements.

The yard dealer in the smaller town receives the material from the collector, and either assorts it himself, if he has sufficient tonnage to make this advisable, or, if he cannot assemble sufficient at a time to make up carloads of various grades, he sells it by the carload without sorting to the city dealer who has better facilities. The latter pays less for the mixed scrap and the small dealer loses part of the value that would come to him for his services in classifying the mass. The city dealer unloads the car into his yard and separates the various grades for the iron, steel and foundry trade.

While the assorting task may seem at first glance to be intricate and complicated from the viewpoint of the uninitiated, it really is an easy matter to those prepared for doing it. As proof of this, it may be stated that a properly equipped yard can put a carload of mixed scrap through the process in approximately one day, the car received one morning being completely sorted and prepared by the following morning.

The capacity of a yard to handle mixed scrap thus is determined by the number of gangs and shears the yard possesses. To the dealer the process is simple and the class of labor employed need not be skilled. The scrap is separated into five classes: malleable, machinery cast, stove plate, melting steel and rolling mill scrap, which by a little assorting and shearing magically become classified grades ready for shipment to consumers.

Railroad mixed scrap consists of everything in the iron, steel and cast material that a railroad uses. This includes locomotive and tender scrap, car scrap, track scrap, including rails, and shop scrap, varied in classification in the proportion of the road's activities in the scrap business.

Railroad mixed is of better quality than dealer's mixed because of the care exercised in inspection by railroads on all materials they buy, in the interest of safety and economy. It therefore commands better prices; and for this reason and also competitive reasons, the small dealer usually allows his city associate to handle the mixed scrap produced by railroads.

As a general proposition, railroad mixed scrap consists of wrought, steel, cast and malleable, and is assorted and prepared accordingly.

Yards also handle other classes of mixed scrap, coming from abandoned and discontinued enterprises, dismantled factories, mines, bridges and structural material. These all go through the dealer's "melting pot" and come out as fodder for the seemingly insatiable appetite of the ferrous industries.

A well equipped scrap yard contains shears, a magnet for unloading, handling and loading, a drop for breaking large pieces to size convenient for handling, a locomotive crane for moving cars and handling heavy and unwieldy pieces and a few oxy-acetylene torches for reducing such bulky material as boilers, tanks and structural steel. Most yards are not as well equipped as here indicated. In fact, outside of yards operated by large dealers, the average yard equipment consists of a shear or two. Even

so, results obtained are remarkable when the small facilities at command are considered.

Scrap dealers are not the only ones maintaining yards for working over scrap to make it better suited for use. Both steel and iron mills buy material in what may be called a crude form and put it into condition to be utilized in their processes.

This buying is done by steel mills for two reasons, economy and necessity arising out of market usages. As an example, most steel mills buy or accept long steel rails, both railroad and street railway, as they come from the tracks, in random lengths, at the same price as heavy melting steel. They do require, however, that this long material must be loaded separately from scrap of charging-box size, and some mills limit the proportion of long stock to the total shipment.

The American Steel & Wire Co., for instance, calls this "shear stock" and includes T rails, girder rails, shafting, I-beams, and other structural shapes not over 4 inches across the top; angle irons, Z-bars and other forms, of any length, but not badly bent or twisted. Railroad frogs and crossings must be cut apart. This all must be loaded on separate cars from chargeable shape scrap. This specification is fairly characteristic. Other mills vary it somewhat, but the general practice is well represented in this paragraph.

Inasmuch as the open-hearth furnace cannot handle material over 5 to 6 feet in length in the charging box, and some specifications limit this to 3½ feet, it is necessary to reduce this material to proper length to pack into the charging box.

To accomplish this, it is sheared, where the shape is convenient for that treatment, or broken. Two methods of breaking are used, the bulldozer, where power is applied to fracture them transversely; or the hand method, a simple procedure of much efficiency. This requires only a sledge and a steel cold chisel, a few laborers being sufficient to reduce a large tonnage to size in a short time. This is a cheap method and gets good results.

The rail is placed on one side, resting on two supports elevating it slightly from the ground. The sledgeman and an assistant nick the rail on head and flange at proper intervals by the use of the sledge and chisel. The rail then is turned over and nicks are placed on the other side at points exactly opposite the first series. Then with a heavier sledge the rail is struck opposite these nicks in turn, and a single blow is sufficient to part the rail cleanly. It is an elementary, even crude, method, but it obtains the full result sought. A small crew with a little practice accounts for a surprisingly large tonnage in a day.

Some mills accept long structural steel as heavy melting steel, and reduce it to charging box size in large shears, usually the alligator type, which have great power.

Mills accept these forms of scrap on the same basis as heavy melting steel for two reasons, as stated before. One reason is that a certain percentage of heavy steel is necessary to obtain best results from the open-hearth furnace, and rails or structural forms supply this. Demand for short rails and structurals from iron foundries, open-hearth steel foundries and malleable concerns is such that large mills would not receive this material with

their regular classification for heavy melting steel unless they accepted it uncut and at the same price as the shorter stock.

If dealers were forced to bear the cost of shearing and breaking, they would dispose of it to other users at a higher price, which would cover the expense of preparation. Mills have better facilities than foundries for doing this and thus have an advantage over other users, who must have this work done by the seller in his yard.

An economic feature appears in the fact that mills handling such scrap are able to round out their total requirements by including such scrap in their classification, and thus are less dependent upon the producer of scrap. This reduces the demand for prepared scrap somewhat and effects an ultimate saving.

Mills not having sufficient pig iron for their needs buy heavy cast iron in the form of large engines and machinery in pieces weighing sometimes up to 10 gross tons. These are broken to charging-box size under a heavy drop. Well equipped mills have an elevated structure equipped with a traveling crane. This carries a magnet which raises a heavy iron ball, known as a "skull cracker", which is dropped from a considerable height and breaks the heavy castings by the impact.

In some cases a locomotive crane handles the magnet and "skull cracker". This gives good results, as the crane can be moved to the heavy casting instead of moving the latter to the crane. Cast iron car wheels are broken in the same way to make them proper size for the charging box or cupola.

SCRAP METALS

Some open-hearth steel mills now are buying loose black sheet clippings and baling them in hydraulic presses. These bales are being made extremely compact, as much as 200 pounds of clippings being compressed into about 12 x 12 x 6 inches. These bundles are used as melting stock, in connection with solid material.

At present there is not a heavy demand for light clippings on account of the difficulty of handling them, and mills using hydraulic presses for compacting them, can buy the loose clippings at a low price compared with equal tonnages of other forms of steel. Losses in melting these compacted clippings are small and practice is most satisfactory when a certain proportion is charged with other steel.

Though there are more than 100 grades of iron and steel scrap of recognized value, the grades into which most scrap falls are comparatively few and a summary of these will give an excellent idea of the classification covering the greater part of the tonnage involved.

Open-hearth melting steel is one of the most important and of this there are two principal grades. Heavy melting steel consists of all heavy iron and steel scrap in compact or uniform shape, cut to charging box dimensions, 5 or 6 feet long and 15 to 20 inches wide. This includes bars, shapes, rails and plates. Shoveling steel is the other open-hearth grade and consists of small pieces of iron and steel scrap, not over 8 to 12 inches of surface area, such as could be shoveled into the charging box. The name was given originally because of the fact that it was shoveled. Later development has brought the use of magnets but the name remains.

Shoveling steel fills the nooks and crevices between larger pieces in the charging box. This grade is made up principally of punchings and shearings of bars and plates and other small scrap.

Wrought iron rolling mill scrap comes in four principal grades, No. 1 railroad wrought, No. 2 railroad wrought, No. 1 busheling and No. 2 busheling.

No. 1 railroad wrought consists of all wrought iron scrap from railroad equipment that is 4 inches or more in length. Mills using this grade usually operate shears to prepare scrap for fagoting purposes. The operation of such equipment by mills to prepare scrap for their own use will be taken up later.

No. 2 railroad wrought consists of wrought scrap too short to be classed as No. 1. It includes spikes, bolts, nuts, bar crops, punchings and other similar material. This corresponds in the iron mill to shoveling steel in the open-hearth. It fills the small spaces between pieces of No. 1 wrought in building up the fagots from which bar iron is produced.

No. 1 busheling consists of cut plate, sheet and pipe scrap, 8 inches or shorter, 12, 16 or 18-gage or heavier. No. 2 busheling is the same kind of prepared scrap but it consists of the material too light for No. 1 busheling.

It will be noted that three gages are enumerated in distinguishing between the busheling grades. This is because some mills specify down to 12 gage while others give a leeway up to 18 gage.

This distinction is arbitrary and a matter of taste because the process of "busheling", known as "puddling", when pig iron is the raw material, is universal in this coun-

try and the dividing line between No. 1 and No. 2 busheling as it affects wages is 19 gage. Thus, as far as the men engaged in the process of busheling are concerned, their earnings are not affected whether they use material of 12 gage or 18 gage.

It is only natural, however, that a mill allowing up to 18 gage will receive preference from the dealer over one that draws stricter lines. In the former case the probability of rejections is smaller and rejections are the bane of the scrap dealer's existence.

It is obvious from the above that shoveling steel, No. 2 wrought and No. 1 busheling are of less importance and do not possess the same values as the prime grades. However, the difference in price of associated grades, shoveling and No. 2 wrought, compared with heavy melting and No. 1 wrought, is small, naturally depending upon supply and demand. In fact, in some districts the spread between heavy melting steel and shoveling steel has become so small that it is of no consequence and the consumer pays the same for both.

Many observers believe the day is not far distant when the same thing will apply to No. 1 and No. 2 railroad wrought, on account of the similarity of their use.

No. 1 cast scrap consists of iron castings broken to foundry cupola size. Malleable scrap consists of malleable iron castings of two classifications, agricultural and railroad. The former consists of light malleable castings from agricultural implements and similar machinery. The latter includes somewhat heavier castings from railroad equipment. It commands a better price because of its weight and uniformity.

Another important class of scrap is low phosphorus or basic steel scrap, used by producers of basic steel products. This is supplied in charging box size and consists of basic steel castings, punchings, plates, car coil and leaf springs, knuckles, couplers, axles, billet and bloom crops, steel wheels and other forms. It is necessary to guarantee the basic quality of this grade and it commands a premium over ordinary melting steel.

CHAPTER X

Scrap for Bar Iron

Bar iron rolling mills, manufacturers of merchant bar iron, do more work in the preparation and classification of scrap than do steel mills or any other user of scrap. In fact, they give nearly as much attention to scrap yard operation as to their mill operation. This is due to two reasons. First, as the manufacture of bar iron is strictly a hand process, from the preparation of fagots, from which bar iron is rolled, to rolling and shipping, it is necessary that great care be exercised in the selection of scrap. If this be not done, disastrous results, giving defective bar iron, will follow inevitably. Second, to secure uniform and satisfactory results, it is necessary that they prepare a certain portion of their scrap themselves.

To illustrate, No. 1 railroad wrought iron consists of wrought iron scrap from railroad cars and shops and is, as a general rule, an unsightly lot of material, consisting of rods, bars and bolts, often twisted and bent, shaped material, bolted material, brake levers and staffs, all loaded helter skelter in the cars. All this must be straightened and cut to certain lengths, depending upon the size of the fagots to be rolled.

Dealers could do this work in their yards, but inasmuch as mills use their scrap in different lengths, depending upon the size of the fagots, the weight of which are calculated from the lengths of the resultant bars and the

mills operate 8-inch, 10-inch, 12-inch, 16-inch, 18-inch and 20-inch, or larger mills, for which the fagots are prepared; and as there is a wide variance in taste among mill superintendents, the only satisfactory way to classify this grade is to ship it unprepared and work it over themselves.

Some of this work is done in dealers' scrap yards but not to any appreciable extent. In the old days of iron-making, when the industry was in its infancy, some mills, being short of shearing facilities, had to depend to a large extent upon dealers for prepared wrought scrap. For purposes of convenience, mills later installed shears, and as their requirements grew they found it necessary to enlarge their scrap-handling facilities to reduce their dependence upon dealers. Finally, when their wants grew to large proportions, they found it absolutely necessary to place themselves in a position to prepare a greater portion of their requirements to avoid irregularities or interruption of operation.

In the old days there were not by any means the number of scrap dealers that exists today. In fact, in mill districts where there are now perhaps 100 dealers in business, there were only two or three dealers 30 or 40 years ago. It is evident from this that there could not have been the extensive classification of scrap in those days that exists now.

Therefore, the mills had to buy country mixed wrought scrap to round out their requirements and this required shears and other facilities for handling it. This branch of the mill business is retained by the iron mills today and, in fact, an iron mill seems to have more the appear-

ance of being in the scrap business than in the mill business.

The importance of constant, careful attention to the manufacture of their product, covering a big range of scrap, necessitates this. There is no pretense of denial that mills profit by preparing uncut or unclassified scrap. They save the freight charge that would be incurred if the scrap went through a dealer's yard, and save the profit made by the dealer. It is also a fact that scrap of any kind can be bought unprepared and worked over by the mill at less cost than prepared scrap can be obtained. This means an additional profit to the mill, to which must be added the saving effected by the reduced demand on prepared scrap for which, of course, more would have to be paid if they relied entirely upon dealers to furnish them only prepared scrap.

Considerable of interest is found in a view of mill operation in utilizing its busheling scrap.

This consists of cutting or shearing pipes and flues, both light and heavy, sheets and bands and plate scrap. This is cut into pieces 8 inches or less in breadth. This scrap is charged into a small reverberatory heating furnace through a small door, necessitating the use of short or small scrap. In addition, it is a fact that the shorter the scrap the better results are obtained, because of the greater surface exposed, resulting in better mixing and welding and thus uniformity of product. After being exposed to the heat for a few minutes, it is worked or "busheled", as the operation is called. The "busheler" attacks the melted charge vigorously with long iron tools, 8 or 10 feet in length, and when the mass

becomes white hot and thoroughly mixed and stirred into a plastic and weldable state, he withdraws it and transfers it to the squeezer rolls, where it is squeezed into the form of a rough bloom. It is then transferred to the busheling mill roll train, where it is rolled into busheled scrap bar.

This is a rough bar and after being cut into short lengths it forms the four sides of a box without ends, on the inside of which the fagotting scrap is piled; and the entire fagot then is wrapped with wire and transferred to a furnace for heating. The heated fagots are then rolled into merchant bar iron.

The term busheling is analagous to the term puddling, which is understood by most iron and steel men. They represent practically the same process except that in puddling, pig iron is used; and in busheling, scrap is the material. Busheling has virtually replaced puddling in recent years, on account of the advent of steel which had caused a reduction in the price of bar iron at some expense of quality.

Puddled wrought iron now is used only for high-grade purposes, where its quality commands a premium price. Little real puddling is being done at present because of the small demand for puddled iron.

In the busheling process machine shop turnings are used, being shoveled into the furnace first to provide a bath of molten metal for the charge of bulkier and heavier busheling scrap, and adding density to the mass.

Mills object to brass or other metals or cast borings in their turnings because they are metals possessing a lower melting temperature than iron and steel scrap;

and this also is true of cast iron stock, in line with the proven rule that any mixture of metals possesses a lower melting temperature than the individual melting point and becomes molten first. Being of greater density than the unheated iron and steel, it sinks to the bottom. The furnace bottom is made of sand in a busheling furnace and this melted mass is injurious and makes it necessary to replace the old bottom with a new one, thus causing loss of production while repairs are being made.

For this reason, machine shop turnings for an iron mill must be free from brass, copper, babbitt and cast iron. Additionally, if these injurious elements remain in the metal, they prevent perfect welding of the iron and steel scrap and cause an inferior product.

Busheling scrap has two classifications, No. 1 and No. 2. The former applies to heavy scrap and the latter to lighter material. The busheler is paid on a tonnage basis, measured by the quantity of No. 1 busheling he uses and so much for the No. 2 busheling. As No. 2 busheling is the lighter, the busheler cannot produce as much scrap bar as from No. 1 busheling. For this reason, he receives more money from his employer for working No. 2 scrap.

The dividing line is No. 18 gage; anything lighter than this being classed as No. 2 busheling. Some mills, however, as previously stated, accept material as thick as No. 12 gage and heavier for No. 1 busheling. Others will accept up to No. 16 and some up to No. 18 gage. This seems to be only a dissimilarity in taste, because, as far as the busheler is concerned, he is not interested

except that No. 18 gage or heavier means No. 1 busheling to him and lighter gages No. 2.

It is natural that mills giving shippers the widest latitude in this respect buy scrap for less money than those that place restrictions of an unfavorable nature in their classifications.

CHAPTER XI

Scrap Replacing Pig Iron

Although the market price of scrap normally is lower than pig iron, large steel companies with ample blast furnace capacity can produce pig iron more cheaply than they can buy scrap on the usual market. Being self-contained and taking all the profits from ore to steel, they find the pig iron in the mixer is cheaper than scrap in the charging box, when the latter has to be bought. The scrap produced in the mill from crops and rejections does not count at the same cost.

Additionally, direct iron, which is already molten when poured into the open hearth, is transformed into steel more quickly and at less cost than cold scrap can be melted and converted, so a further saving is made by the use of pig iron.

Thus it comes about that some of the largest producers of steel are comparatively small users of steel scrap. Except when steel-making capacity is greater than blast furnace capacity, sufficient scrap of its own making is available without buying constantly in the market. Probably all steel mills buy large tonnages of scrap in the market, but relative to the output the larger mills buy less than those with smaller pig iron producing facilities.

Steel foundries with open-hearth furnaces are large users of heavy steel scrap, as it is bought more cheaply than pig iron in the ordinary market, and both must be melted from the cold state in the furnace. In this prac-

tice any proportion of scrap is used, some melters using only scrap while others use pig iron up to 20 per cent of the mixture.

In cupola practice, the proportion of scrap to pig iron varies with the result desired, 50 to 80 per cent of scrap being used in many instances. The more closely the foundryman buys his scrap with respect to analysis, the larger proportion he can use in his mixture. If the scrap has excess silicon above what he needs in his product, he can use safely a high proportion of scrap without providing that element in a high silicon iron.

Custom has changed much in respect to scrap in the cupola, and increasing use is being made as foundrymen find its usefulness and lower cost as compared with pig iron. Formerly nothing was considered possible in gray iron foundries except carefully selected pig iron and a little of the scrap from sprues, risers and defective castings. Now a wide range of scrap is used and gives as good results as the straight pig iron formerly used.

Use of iron and steel scrap instead of pig iron in the open hearth and replacing iron ore in the blast furnace is economical when scrap is the same price as the pig iron and twice the price per ton of the ore.

This comes about for at least two reasons. Heavy melting steel is as easily handled and melted in the open hearth as is pig iron, unless direct hot iron is used, as in the case of self-contained steelworks making their own pig iron. But in converting pig iron into steel in the open hearth there is a loss of tonnage from the removal of carbon, phosphorus and other metalloids. Ordinarily about 4 per cent of carbon is removed, with smaller

proportion of phosphorus, silicon and sulphur, the ordinary loss being about 8 per cent.

Heavy melting steel goes into the furnace with an analysis fairly close to the steel that will come out, thus giving a higher output of metal in proportion to the tonnage charged than in the case of pig iron. In the case of one large steelmaker, it is figured that when pig iron is taken as a basis at 100 per cent, heavy melting steel yields 105 per cent by comparison.

For this reason a steelmaker who buys his pig iron and scrap in the market will find lower costs in the use of heavy steel scrap than in using pig iron, if each kind of raw material costs him the same. But scrap usually ranges about 10 per cent lower in price than pig iron, which gives a larger difference in cost.

Of course, a steelmaker having his own blast furnaces produces pig iron at a lower cost than the price at which merchant iron can be bought, probably lower than the the market price of scrap under ordinary conditions. In that case pig iron is the cheaper raw material. With its own mill scrap, crop ends, trimmings, defective rolled material and the like it frequently happens that a large steel mill buys a proportionately smaller tonnage of scrap than some smaller mill which has to buy all its raw material for its open hearth.

In the case of the blast furnace it is the rule that 2 tons of ore are necessary to produce one ton of pig iron, ores ordinarily used being about 50 per cent iron. When borings and turnings are charged the yield is practically a ton of pig iron for every ton of scrap, giving a higher yield for the material charged. There is a saving

of coke also in this practice since there is no metallurgical process involved, simple melting being needed. The same is true of other scrap charged in the blast furnace, mill scale, skulls, spills.

Of course, in all melting operations some losses are met by the slag taking up some of the iron or in oxidation. In the blast furnace this is corrected to large extent by the reducing effect of the carbon and its gases, the oxides formed being essentially the same chemically as the ore.

In addition to this the large use of scrap is a measure of conservation and every ton utilized saves 2 tons of iron ore. On the tonnage used in this country every year the saving in the reserve of ore in the ranges thus totals 25,000,000 to 30,000,000 tons. Over a period of years this is an immense saving in the ore resources of the country.

An important item of steel scrap is the steel rail. When a railroad removes a rail from its track, it sometimes uses it to replace a lighter section on a branch line where traffic requirements are not so severe as on a main line, or places it in a sidetrack where it may have several years of usefulness before becoming scrap.

But the requirements of well-maintained main lines cause replacement to a greater degree than branches and sidetracks can absorb. The excess of rails then is sold for scrap. The rails from branches and sidings also are loaded on cars and sold as scrap.

These divide into three general classes. Rails suitable to be used in sidetracks leading to coal mines, lumber camps and in industrial tracks are sold as relayers,

their condition as well as demand being the determining factor. Recently relayers have sold at a higher price than standard rails, their immediate availability in the face of long delays for new rails giving them added value.

Rails too much worn for further use are sold as re-rollers. These are used in the production of steel bars and angles, known as hard bars, from the carbon content. Short lengths of rail are sold as heavy melting steel and are remelted in the open hearth. Frogs, switches and guards, which are made of steel rails cut, fitted and bolted into form, are cut apart into their original form and sold for heavy melting purposes.

There is one other destination for old rails which diverts them from scrap, but it is utilized to a limited degree. This is a rerolling process in which the rail is heated to rolling temperature and rerolled in a rail mill to reduce its section and give a lighter rail for further use. The reheating relieves the "fatigue" or crystallization resulting from vibration in the track, and the added rolling tends to improve the quality of the steel. In this process the mill usually charges simply for the service and the rails remain the property of the road, being simply made over into a smaller section.

In the rerolling mill making bars and angles, the rail is destroyed as such. It is heated in a suitable furnace and passed through rolls that cut apart the head, web and flange. These three parts then pass through further rolls and are transformed into finished product. The head of a heavy rail will yield rounds or squares up to a fair diameter, the web is rolled into flats, and from the flange angles are made. The size of the completed prod-

uct depends on the dimension of the rail, since the steel must be subjected to pressure in rolling and this reduces its dimensions.

These bars and angles are used for reinforcing concrete, for the manufacture of metal bedsteads and in many other places. Implement and vehicle manufacturers and car builders use hard bars for many purposes where they serve fully as well as soft steel. Usually they are cheaper than soft steel, but during the war period they have been at a higher level and the maximum price fixed by the government placed them at several dollars a ton over soft steel.

Some dispute has existed from the first as to the value of this steel, but whatever prejudice has existed is being worn away and it is a recognized product now. The argument of the makers is that if the rails be good steel, the bars made from them must be better since they have been heated and subjected to further rolling, which is always a means of improving the quality of steel.

Some rerolling mills have rolls sufficiently large to roll bars from iron and steel axles and from billet crop ends, and some fine profits have been made in this way in times of heavy demand for bars.

From a locomotive tire to a shovel, from duty in speedy transportation and heavy tractive effort to a lowly implement handled by track workers or trench diggers, this is the fate of steel that has served its time in the former capacity. Locomotive tires are high-carbon steel in order to serve well and wear well in the exacting service of the locomotive. When worn past usefulness and discarded, the tire is cut or broken into four pieces as evenly

as possible and used as a billet by the manufacturer of shovels.

These manufacturers have their heating furnaces and rolling mills designed for this service and the piece of tire is soon rolled into a sheet which is cut and pressed into shape for the blade of a shovel. This analysis of steel serves best for shovels, giving hardness and rigidity necessary where soft steel sheets of the same gage would not serve.

Shovels also are made from sheets rolled from high-carbon discards from steel mills, much of which is available while mills are turning out heavy tonnages for the manufacture of shells. Old steel rails are of the proper analysis for shovel making, but efforts to use them in this way have not been entirely successful. It is not feasible to roll the entire rail into a compact billet without seams and when it is separated into head, web and flange, as in rolling bars, nothing but the head is sufficiently large to give metal for making the sheets.

In fact, at a differential of $10 or more a ton in favor of rails it is more economical to use tires for this purpose, the waste from rails, which must be disposed of as low-priced scrap, being more than an offset for the difference in price.

Since tires contain a high percentage of carbon they are valuable for rerolling and except when there is a heavy excess in proportion to demand, which seldom comes about, they are not likely to be included in other classifications of steel. Their destiny seems to be cut out definitely for the shovel manufacturer and the same steel that once rode the rails at high speed may in its next incar-

nation be devoted to shoveling ballast under the same rails, equally useful but less spectacular.

This is a clear illustration of the highly developed state of the manufacturing processes and the scrap supply, fitting the discarded material to its most useful destiny, giving a lower cost for the raw material and at the same time a higher price for the scrap, both seller and buyer obtaining an advantage, and at the same time conserving value and relieving demand on similar material from the steel mill, which would be more costly and at the same time absorb additional raw material in its manufacture.

CHAPTER XII

Adapting Difficult Scrap

Continual effort is being made to render available forms of scrap which have not been easy to use on account of physical characteristics.

Cast iron borings and steel chips, the latter being produced in lathe work and by milling machines, have been desirable material to use in the foundry cupola, from a metallurgical point of view, but on account of their tendency to oxidize before melting and to blow out of the stack in the blast, losses have been too great.

Compacting them by mechanical pressure has been found too expensive for general use, although some progress has been made along that line and ultimate success may be achieved for the process. Compacting brass borings and chips has attained a successful stage and great solidity of product has been obtained. In this case pressure and a sudden shock have been combined and the result has been to "flow" the particles and give a solid mass.

Borings and turnings in the cupola reduce the cost of mixture and better the quality of the iron. The only drawback has been the melting loss. The first method giving success was patented by Asa Whitney about 30 years ago. He used a wooden box as a container, the contents being sufficiently heated before the box burned away to give a comparatively low loss. This plan is used now by many foundries with good results. Numerous

other plans have been worked out, and in the effort some of no use have been put forth, but fell of their own weight when put to the practical test.

Melting these materials loose in the cupola has been tried. When charged alone the mass does not heat really throughout and only the outer edges are melted. When mixed with other material the chips are blown out by the blast and there is heavy loss. These methods have had to be abandoned. Another method is to lay a thin bed of borings in the cupola, the molten iron from above melting the borings as it descends. But this absorbs heat from the iron and gives a lower degree of heat in the ladle.

Placing the borings and turnings in metal cans seems to have given the best results. In a paper presented before the American Foundrymen's association, James A. Murphy, a practical foundryman, of Hamilton, O., explained this method. He states that 30 or 40 years ago a foundryman in Scranton, Pa., placed borings in old powder cans for charging into the cupola and obtained good results. When the supply of cans ran out no substitute was used, wooden boxes being resorted to again.

Showing the value of trivial things to the observing mind, Mr. Murphy relates the experience of Stanton Griffith, foundry superintendent for the Fairbanks-Morse Co., Beloit, Wis. An empty tomato can got into the heating furnace at his home and resisted efforts to melt it down, remaining in good preservation for several days. This gave him an idea, and as the tomato can was too small to be of service, he used a length of stove pipe, placing a disk in each end and crimping the pipe over to hold it in place. Tests have made many foundrymen

believe no other method is as good for handling this grade of scrap.

The cost of preparing it is about $2.50 a ton. One method is to have the borings and turnings placed in the cans at the machines where they are produced, saving handling.

In tests by Mr. Murphy, where he melted 10 tons of these cans without other material, he found an actual loss of less than 2 per cent, the material being weighed before being charged and after being melted. The iron was white and not fit for commercial machinery castings, fluid and hot but not showing a tendency to stick to the ladle.

Briquetting borings by the use of a binder has been tried but seems to have failed. Moisture in the binder causes rust, producing pinholes and blowholes in the castings. Melting loss by this method has been found to reach as high as 60 per cent. Similar metal melted in cartridges of stovepipe gave castings sound throughout and lacking pinholes and other defects.

This simple method is not patented and can be used by any foundryman. Enclosing the borings or turnings in wood or metal containers to hold them until thoroughly heated seems to solve the problem, both in experiment and in actual practice. This renders available the great mass of this relatively cheap material which otherwise could not be applied successfully to renewed use as steel or iron.

Sheet steel made into tinplate and then into containers is largely lost material because of the cost of collection. The same thing has been true to a great degree of scrap

tinplate resulting from making these containers, though this form of scrap is available in large tonnages at the plants making cans. There was a time when this was hauled away as waste and dumped as filling, to rust and disappear.

The obstacle to its use as scrap was the presence of the tin coating which is a detriment in an iron or metal mixture, as has been explained in a previous article, on account of its different melting point from steel.

During the past few years efforts have been made with a great degree of success to remove the tin and solder from tinplate scrap. This is called detinning. Two products are obtained, the tin and the steel sheets.

Two distinct processes are used in detinning. One is electrolytic, in which the tin is recovered in metallic form, smelted and sold as pig tin. This product brings a high price at present and is a matter of conservation, as the supply of tin is far below needs.

In the other process chlorine gas is used, uniting with the metallic tin on the scrap and producing tin tetrachloride. This is a heavy anhydrous liquid used by silk dyers as a mordant and for weighting silk.

The detinned scrap is compacted in billets and is used in open-hearth practice as heavy melting steel. The compacted scrap is compressed to a density giving about 110 pounds to the cubic foot. This compares favorably with the weight of other steel used in steel furnaces and the compacting is sufficient to give easy melting without undue loss of material from oxidation at high temperature.

Another method of detinning is now being experimented with by the bureau of mines at its experiment station at Seattle. This method consists of volatilizing the tin in an electric furnace and recovering it pure, in metallic form. Experiments have been delayed by difficulty in obtaining electric furnace equipment and results have not yet been obtained sufficient to draw conclusions of value. However, the work has gone far enough to indicate it is of value and that it probably can be made commercially available when the research has been completed.

In these experiments particular attention is being given to recovery from waste tin cans rather than new tinplate scrap and the tin is the valuable product rather than the residue of steel scrap. But if the tin can be recovered profitably the steel scrap will become available as steel, thus adding to the total scrap for replenishing the nation's supply.

The practice of one of the largest can manufacturing concerns in the country is of interest. Treatment of the various sorts of sheet scrap varies. Tin plate is handled like hay, with forks, packed into box cars and trampled as solidly as possible to give weight in the load, shipped to detinning plants and there the tin is reclaimed from the steel, as has been told previously. The usual practice is not to bale or compress tin plate scrap as it is more readily detinned when not compacted. In plants where it is necessary to store the material until carloads are accumulated before loading, it may be baled by tramping it into boxes or by baling in a press similar to hay baler, which gives some reduction in bulk without binding the material tightly.

Terne plate is treated much the same way but this is rather a heavier product, due to the heavy coating of lead, and packs somewhat more firmly. Galvanized sheet scrap is of small value and usually is used only for melting in a cupola and casting into sash weights, elevator weights and other articles where weight is the only quality needed and strength does not figure. The resulting casting in this case is brittle and breaks easily. Often it is necessary to have the galvanized scrap carried away and dumped for lack of an outlet. Means of removing and saving the zinc coating have not been found profitable up to this time.

Black and blue annealed sheet scrap is baled under hydraulic pressure into hard, compact packages, almost ingots, and are sold as heavy melting steel for use in the open hearth. In its highly compressed condition it serves well in the open hearth. This is the same final condition that the steel sheet scrap freed from its tin or terne coating meets, the high compression in the case of the latter being reserved until it has been cleared of its coating.

Thus it appears that sheet scrap is handled differently according to its nature and the subsequent treatment it is to undergo. When it is ultimate scrap, as in the case of the uncoated varieties, it is compacted at once for melting; but where it must be freed from its coating of other metals, it is left as loose as possible to allow the detinning process to act on all surfaces in a loose mass, which would be impossible were it packed tightly as a hydraulic press leaves it.

Sheet scrap thus yields back all its metal, steel and coating material, except in the case of zinc-coated or

galvanized sheets for which no profitable process has been found. This steel then is dead loss to the world's store as valuable iron except so far as its use in weights relieves demand on more valuable grades for this necessary purpose.

A larger percentage of the scrap from can factories thus is recovered than of the material which goes into the manufacture of cans. Since it is concentrated and can be handled in bulk, it is of value, but the cans are scattered to a million separate destinations before being opened and cast aside and cannot be reassembled for reclamation, as has been pointed out in a previous article, except when they are gathered to get them out of the way, in the process of removing rubbish in a city.

In foreign countries, where iron and steel scrap is of more relative value than in the newer United States, some interesting results have been obtained in reclaiming used tin cans, both the solder and steel being recovered at a profit, as well as adding to the supply of these materials, which must be imported in their new form.

At Hornsey, England, where a waste reduction plant is maintained, waste gases are used on their way to the stack to melt solder from cans, allowing its recovery and further utilization. Thus the cost of collecting is not charged against the value of the scrap recovered and the cost of detinning is not chargeable, since it would not be available for other use, the heated gases being wasted through the stack. Were a special furnace needed the process might not be profitable. The capital investment to make possible this process was about $1000. The ordinary yearly collection of scrap is about 200 tons

in Hornsey. Of this about 135 tons is tin plate scrap, 30 tons light scrap, 25 tons galvanized scrap and 10 tons enamel scrap.

In this small unit the tin is not recovered, but is burned off, volatilized by the heated gases from the incinerator destroying garbage and valueless refuse. The solder is collected in a trough and the cans are removed and baled by a hydraulic press. Bales are made up about 15 x 27 inches and 4 inches deep. These are sold to steel mills as bundled scrap. The solder is skimmed and marketed to dealers in nonferrous metals.

The Hornsey works makes a profit of about $1000 per annum from these forms of scrap, in addition to the saving of expense for hauling it to a dump. The reclamation process is carried on with little additional labor. Better prices would be obtained for the bundled scrap except that no steel mill is nearer than 200 miles, making a long haul. A city situated closer to a steel plant would make a proportionately larger profit because of the shorter haul.

Waste heat from any furnace could be applied to this end, provided the temperature is sufficiently high to affect the tin coating. In this process the effort is to reclaim the sheet steel in the cans rather than the tin, the solder giving an added product to add to the profit.

A continuous detinning process for the recovery of tin and solder and salvaging of the steel in tin cans has been invented by J. H. Hall, of Aston, Birmingham, Eng. This consists of a revolving inclined cylinder, placed inside an outer cylinder lined with fire brick. Temperature from gas or oil burners increases from the top

toward the bottom. Cans are fed in at the top and pass out at the bottom, the tin and solder melted off being collected from channels in the cylinder. The cans then are baled as in other processes.

Quality of the product to be turned out by the scrap consumer has a great bearing on the sort of material he is able to utilize. While some forms of iron and steel scrap are not available for fine machinery castings or other uses where quality of the casting is important, there are other uses where quality has no bearing and any material which will melt and can be poured is of use.

As representatives of this class window and elevator weights may be mentioned. These weights are valuable simply for their weight and the quality does not matter, since they are subjected to no strain or stress.

Foundries making this class of product utilize sheet clippings, old cans, blast furnaces salamanders, grate bars and annealing boxes from sheet mills and malleable foundries. These forms of scrap are cheap compared with other materials and can be used at a profit, even for products selling as cheap as weights.

The tinplate clippings usually are detinned and then are bundled before being charged, to give some density and prevent as far as possible losses in melting. Borings and turnings usually are too high-priced to be used for this purpose.

Annealing boxes are becoming of more importance in the scrap market and malleable foundries and sheet mills find sale of their broken and burned-out boxes a source of income. They are utilized in several ways, sometimes for production of cheap castings and also for

charging into blast furnaces with ore and borings, the iron being renewed by the metallurgical action of the coke and limestone and the burned boxes being richer in iron than the ore.

Burned iron, including grate bars and other forms, usually produced by railroads in their locomotive shops and to some degree also in steam plants, is another cheap form of scrap utilized in making cheap castings where quality is not important.

When these weights reappear as scrap they are of higher value than the scrap from which they were made as their subsequent passage through the cupola or blast furnace refines the iron and gives it a new lease on life.

CHAPTER XIII

New Processes Enlarge Use

With each development in the manufacture of steel, as new processes come into use, changes are made in demands on the iron and steel scrap market. Frequently it has happened that some new discovery in metallurgical practice has brought into prominence some grade of scrap formerly not of special value and has caused it to be sorted out from other grades and marketed alone for a particular purpose.

The newest method of melting or refining scrap into steel of high grade is the electric furnace, and special scrap is demanded for this purpose. These furnaces operate both acid and basic, though most steel foundries use the acid bottom, because of its cheapness compared with basic refractories. When running acid it is impossible to refine the metal and the furnace simply melts it, ready to be cast into new forms. For this reason, the scrap employed must not carry more phosphorus and sulphur than is desired in the finished steel. In fact, as there always is a loss of total weight in the output compared with the metal charged, it is better to have the analysis of the scrap lower in these elements than is desired in the finished product.

Specifications for low phosphorus scrap for acid electric furnaces therefore provide that both phosphorus and sulphur must be no greater than 0.04. Guarantee of the analysis usually is required by buyers.

For this reason most electric steel scrap is open-hearth, since this is lower in these elements than is bessemer steel, the basic open-hearth process almost universally used in this country removing these elements to a greater degree than the acid bessemer process.

The classification of the American Foundrymen's association provides no less than eleven grades of steel for electric steel furnaces, differing largely in the form and size of the scrap composing them. Reference to these classes as presented in the association specifications will indicate the division.

Boiler punchings are of the proper analysis and provide a favorite shape for electric steel scrap. This is also in demand for crucible steel manufacture, since this is also simply a melting process with little refining action.

In the manufacture of special alloy steels, tool steel and others, in the electric furnace, a basic lining is used and the steel is refined and changed in its analysis from that of the scrap charged. Under these circumstances, it is possible to use any reasonably good scrap and the slag removes impurities and elements not wanted, it being possible to carry the refining farther than in other processes.

The electric furnace allows the use of borings and turnings with great economy, since there is little oxidation, the atmosphere being reducing, which prevents burning and loss of the finer particles. High sulphur scrap can be used in the basic furnace and the sulphur is removed in the slag with great success. There is practically no silicon loss in this furnace and thus a higher proportion of scrap can be used than in other furnaces with a lower silicon

content. Even waste wire, usually of little value, can be melted successfully in the electric furnace.

The electric furnace is used for the production of ferro-silicon with great success, and in its manufacture wrought iron or steel turnings are used with silica rock, usually quartzite, and coke. These turnings must be low in phosphorus as the latter causes the formation of phosphoretted hydrogen, which is dangerously explosive. For this reason, cast iron in borings or turnings is not suited to the process.

Although pig iron is produced from iron ore smelted in a blast furnace, yet iron and even steel scrap are used in the furnace with iron ore in general practice. Customs in this respect vary with experience in different plants.

It is practically the universal custom to put back into the furnace all "skulls", iron and slag adhering to the ladles, mill scale and mill cinder, skimmings, runners and whatever iron is spilled in tapping or pouring. This applies to stacks operated in connection with steel works to a greater degree than to merchant furnaces as all these materials are produced about the stack or mills. The merchant stack also has the skulls, the skimmings, runners and spills.

Mill scale is an oxide of iron which accumulates about a steel rolling mill in the process of rolling steel, a combination of ferrous and ferric oxide, and is about 65 per cent iron. It is considered more in the light of an ore than a metal, is not as easily reduced as ore and its tonnage is not heavy or it would make operation difficult. Mill cinder is the slag which runs from puddling and heat-

ing furnaces into buggies, and also is slag collected from the bottom of soaking pits at steel works wherein ingots are heated. It is a silicate of iron and contains also some mill scale held mechanically. It contains about 60 per cent iron and is difficult to reduce; but, used in small quantities, it is handled without trouble. Using these materials stops an otherwise steady loss of metal.

Skulls and skimmings usually have much slag with the iron, perhaps about 50 per cent. It is worth while to reclaim this in the long run and it does not interfere with furnace operation.

Iron and steel scrap used in blast furnaces includes borings and turnings, annealing pots from malleable iron foundries, and often machinery cast, steel clippings and billet butts. Practice in this respect varies with mill facilities. Where ample open hearth capacity is provided, steel scrap is used there; but if bessemer steel is made and the proportion of scrap to be used is small, the mill's own scrap is likely to be put through the blast furnace. It is cheaper to do this than to sell the scrap or transport it to another plant where it can be used in the open hearth.

This practice is followed by a mill located only 40 miles from another plant of the same concern where ample open-hearth capacity causes the buying of scrap in the market. Yet the former mill melts its own scrap in the blast furnace instead of shipping it to the other plant.

Borings and turnings are bought in the market and mixed with the furnace burden. The greater part of this tonnage goes into blast furnaces where it is melted

without as much loss as in a cupola. It becomes heated gradually with the remainder of the burden and does not oxidize. Whatever oxidation takes place is corrected when the burden reaches the zone of reduction and the iron is recovered.

As a matter of fact, any iron or steel scrap can be used advantageously in blast furnaces to a certain degree. The matter of price and practice determines how much is to be used. With cheap scrap, the percentage is increased, and with scrap prices high less is used.

It is inevitable that in the process of handling hot metal, some must be spilled or otherwise fail to get into the pig iron or metal mixer or to the open hearth. Such metal goes back to be remelted since it is good analysis and needs only remelting to save it.

CHAPTER XIV

Relative Values of Grades

Since iron and steel scrap is used in the production of new iron or steel to supplement the supply of pig iron it is natural that its price should be lower than pig iron under ordinary conditions. It is found by comparison of quotations that usually heavy melting steel, the nearest competitor of pig iron in the manufacture of open hearth steel, ranges about $3 below basic pig iron. This relation has been preserved in the fixed maximum prices announced by the government in 1917. Basic pig iron then was fixed at a maximum of $33 and heavy melting steel at $30, later reduced to $29 for the scrap when basic iron was made $32.

However, these relations do not always hold, and it has happened in times of great scarcity of pig iron that steel scrap would bring a higher price, not because of any inherent value but because of its availability in comparison with pig iron.

Passing from this relation of pig iron to heavy melting steel, it is found that a regular relation, of somewhat indefinite character according to various conditions, exists between all grades of scrap. These are dictated by many factors. Considerations of analysis and ease of conversion enter largely into the price relation and current demand and supply enter in to disturb what might be called for convenience the "normal" relation.

Just what the so-called "normal" relation is it would be difficult to state without much reservation. Two related grades may have a certain spread in price when the market is easy, but under a period of scarcity this differential may disappear and the less valuable may become the equal of the more valuable for a time, or even pass it in price.

The matter of comparative values is of much interest and every dealer and consumer has a fairly accurate schedule in his mind from which he can work, subject to variations as market conditions vary.

One element in which scrap differs from other commodities is that it has no manufacturing cost basis from which to start computation of its value. It depends entirely on supply and demand. In other words, it has no intrinsic value. If consumers want it, it goes up; and if they pass it by, it goes down. If the supply be below demand, it rises; and if there is plenty it goes down. Thus supply and demand constitute the greatest factors in its price.

But it usually happens that when market conditions change, the alteration is fairly equal on all grades and the entire list of quotations moves up or down in comparative unison. Production of scrap of all grades seems to go on with a regular balance so that the occasions are rare when one grade is scarce and another plentiful.

Sentiment enters largely into the price of scrap, and it is more sensitive than other commodities in which the total production can be gaged with some accuracy. It is the belief of many market observers that the probable

course of pig iron prices can be seen in advance by the behavior of scrap. Study of price charts gives color to the truth of this belief, and it is seen frequently that the first break from a steady level is registered first in scrap and later in pig iron. Which is the cause and which the effect is a matter for argument.

An illustration of the effect of sentiment may be seen in the course of the market in 1917. With pig iron selling the country over at $55 at the middle of the year, heavy melting steel was carried to about $40 per gross ton. This price applied on scrap for nearby use while the $55 price on pig iron was for 1918 delivery.

It became the settled idea of the trade at that time that the government would fix prices on pig iron in a short time, and in July scrap began to decline, probably entirely upon sentimental grounds, as consumption had not declined, mills being driven at top speed; and production of scrap was not materially increased except as to the mill's own scrap used without entering the market.

The decline was steady until heavy melting steel had reached well below $30 before the government announced a maximum on that commodity. Soon after $30 per gross ton was set the market turned again and soon reached that level, where it remained.

To illustrate the relations existing between various grades of scrap a table has been prepared in which the various grades usually quoted are arranged in their relative order as they are found under ordinary circumstances. This sequence is fairly accurate, but to apply it to any given situation in the scrap market may dis-

close an apparent error, due to some momentary condition which has thrown one or more grades out of line, as is the case when conditions place the price of heavy melting steel about that of basic pig iron.

There seem to be two classes of differentials between grades. One is relative and the other may be called absolute. Thus borings and turnings seem to be nearly always worth approximately half the quotation on No. 1 wrought. This is a relative differential, which may vary when it is measured by the dollar, according to the particular level of the market. No. 1 and No. 2 wrought usually hold at about $1 difference. This is an absolute differential, though it is disturbed from time to time. It is based upon the difference in cost of using the two grades in the mill. The same is true also of No. 1 and No. 2 busheling and of heavy melting steel and shoveling steel.

Taking heavy melting steel as a base for the gross ton quotations and No. 1 railroad wrought as the base for the net ton grades, the following schedule of relations is offered as fairly accurate, as far as accuracy can be obtained in a classification subject to so many variables in supply and demand. Doubtless it is open to criticism but it is believed to represent as well as can be attained an airplane view of the market under usual conditions, such as could be called normal.

The percentages indicating price above or below the bases have been found to apply in a large number of situations, both in the period before the war disturbed conditions and during the war period. With the understanding that these differentials do not possess

the rigidity which may appear, the table is offered as follows:

GROSS TONS

Iron rails	+ 20 to 40 per cent
Car wheels	+ 10 to 20 per cent
Rerolling rails	+ 10 to 20 per cent
Steel rails, short	+ 10 to 20 per cent
Frogs, switches and guards	Base
Heavy melting steel	Base
Shoveling steel	— 10 to 15 per cent

NET TONS

Iron axles	+ 20 to 40 per cent
Steel axles	+ 30 to 40 per cent
Arch bars and transoms	+ 15 to 30 per cent
Shafting	+ 15 to 25 per cent
Locomotive tires	+ 10 to 20 per cent
Iron angle bars	+ 10 to 20 per cent
No. 1 railroad wrought	Base
Knuckles, couplers, springs	Base
No. 1 cast	Base
Boiler punchings	— 20 per cent to base
Railroad malleable	— 5 to 10 per cent
No. 2 railroad wrought	— 10 to 20 per cent
Cut forge	— 10 to 20 per cent
No. 1 busheling	— 10 to 20 per cent
Agricultural malleable	— 10 to 20 per cent
Steel angle bars	— 10 to 20 per cent
Stove and light cast	— 15 to 30 per cent
Pipes and flues	— 20 to 30 per cent
No. 2 busheling	— 30 to 40 per cent
No. 1 boiler cut	— 30 to 40 per cent
Borings and turnings	— 40 to 50 per cent

In testing this table of differentials actual prices paid by a consumer due in 1917, part of which was under war conditions and part not, was used as a test. It was found that iron rails averaged 32 per cent over heavy melting steel, the highest differential being 43 per cent and the lowest 19 per cent. Rerolling rails averaged 30 per cent, with 22 and 34 per cent as the extremes. The railroad

situation caused this to be much above normal through the entire year. Short steel rails averaged 21 per cent above heavy melting, with extremes of 9 and 36 per cent, also due to the railroad situation, which restricted the marketing of rails. Iron axles averaged 35 per cent above No. 1 wrought with extremes of 20 and 51 per cent. Shafting and iron angle bars were on an equality with No. 1 wrought at times, though normally much higher. This was due to temporary conditions which increased the price of wrought without affecting the other two. Shafting averaged 11 per cent higher, with a high level of 16 per cent. Iron angle bars averaged 10 per cent above wrought, with an extreme of 20 per cent.

However, these unusual situations do not disprove the relations set above, but prove the former statement that given conditions produce broad temporary alterations.

CHAPTER XV

Double Tonnage Standard

While most scrap is handled on a basis of gross tons of 2240 pounds there is a lack of entire uniformity in this respect and net tons of 2000 pounds still are used in some sections on some grades. Eastern markets have gone practically to a gross ton basis, while some western markets cling to the net ton on certain classifications. The heavier grades are dealt in on the gross ton basis universally and the net ton is used on the foundry and rolling mill grades.

Inasmuch as the dealer frequently buys on one basis and sells on the other, and the seller sometimes buys on one basis and keeps books on the other it is necessary to convert the price from gross to net or vice versa. This is accomplished most easily by the use of what is known as a "conversion table." Its use is simple and results are more accurate than is probable from ordinary computation.

The table of equivalents in the appendix presents the conversion by steps of 25 cents from $1 to $50. A brief explanation will illustrate its use. The middle column is the base and usually is printed in a contrasting color, perhaps red, to aid the eye. The left column represents the net equivalent if the central column is regarded as gross and the right column represents the gross equivalent if the central column is regarded as net.

If the price of scrap be quoted at $12 per gross ton and it is desired to convert this to a net ton equivalent, the figure in the left column opposite $12 in the central column shows this is $10.71. If the price per net ton be $12 and it is desired to find the gross ton equivalent, the figure in the right column opposite $12 in the central column is used and this gives $13.44 as the gross ton equivalent.

The table is susceptible of another use when the figures are regarded as quantities rather than values. Should it be desired to know how many gross tons are included in a certain number of net tons the table will give an accurate result.

Let the problem be to determine how many gross tons are contained in 1000 net tons. In this case the figures 10.00 in the central column are taken, $10 being 1000 cents or 1000 tons as one is pleased to regard them. The figures in the left column opposite 10.00 in the central column show 8.93, and the decimal point should be disregarded, the result being 893 gross tons in the 1000 net tons. The reverse problem, to determine how many net tons there are in 1000 gross tons, is solved by reading the figures in the right column opposite 10.00 in the central column, giving 11.20, or 1120 net tons.

To the large seller and buyer of scrap, constantly juggling the figures in his mind, the transposition of one value or quantity for the other becomes automatic and instinctive. He refers to the conversion table only for absolute accuracy but ordinarily thinks in either value as the case requires, without being forced to use the table.

The buyer or seller who does not acquire this facility of conversion by mental process finds this table most convenient and refers to it constantly.

Need for further standardization in the scrap industry is found in the use of both net and gross tons. This is the cause of some confusion and is a relic of times when the country was more loosely held together in a business way than at present.

As the matter now stands, all eastern markets quote on the gross ton basis while some western markets continue to use the net ton for some commodities. As a general statement it may be said that in the west the heavy steel items, such as heavy melting steel, car wheels, rails and shoveling steel are carried in gross tons while the lighter items, for rolling mill and foundry use are quoted net tons.

One great obstacle to getting the western market onto a gross ton basis to make it conform to practice in the east is the attitude of western railroads which ask quotations on net tons. Inasmuch as the railroads are the most important producers of scrap in the west, this net ton practice has been followed.

Another cause of this net ton observance is that many foundries prefer to use the short ton. In making up its specifications for scrap, the American Foundrymen's association provided in its final note that all quotations be made on the net ton basis. This seemed to be an effort to get as far as possible in the opposite direction from the eastern practice, but the recommendation was based upon foundry practice.

Yet all mill costs are based upon gross tons, inasmuch as finished material is figured on that basis, as is pig iron

and other raw material. This necessitates the use of the net and gross ton equivalent table when the scrap is bought in one measure but is used and accounted for in the other. Much the same practice would be to employ the metric system and the ordinary weights and measures at the same time, a source of confusion.

Dealers are so well versed in the equivalent weights of the two standards that they convert from one to the other without difficulty; but to those to whom scrap is only one of many materials handled, this facility in conversion is not so easily gained and it is a matter of some difficulty which could be eliminated with profit.

Recently the government fixing of prices has given some aid in this matter by using gross tons on all grades of scrap on which prices were fixed. Thus, in order to quote in accordance with the government price, it is easier to use the long ton and thus show the relation of the quotation to the fixed maximum. It seems probable that when the war pressure is past, the habit may be fixed to some degree and part of the present confusion may be done away with.

There seems to be no real reason for retention of the net ton in the face of its limited use; it is simply a market habit, and habits are difficult to change. But the section of the country in which the double standard is used is so small compared with the entire market, it seems likely it will disappear gradually and leave the entire market upon a single standard, that now used exclusively in the east, the gross ton.

CHAPTER XVI

Exporting and War Losses

Sources through which scrap iron and steel are secured are so varied that it is difficult to estimate with accuracy the proportion furnished by various channels. It has been stated by one observer that about 25 per cent of the total comes from railroads and 40 per cent is made by industrial plants in crops, plate shearings, borings, and turnings, much of which is used immediately by being turned back into the steel furnace without entering the market. The other 35 per cent is estimated to be shipped by scrap yards, half of which is railroad and industrial scrap sheared, sorted and prepared there. This leaves 15 to 20 per cent of the total to be collected by the junk dealer.

The latter source is more apparent to the outside observer than the vastly larger operations that do not obtrude themselves. While relatively unimportant from a percentage point of view, this source is of great importance, since it is the only one that can be increased.

Higher prices of the present make its collection more remunerative and is having the effect of bringing out much that otherwise would not pay for collection. Efforts are being made in many lines to bring about closer gleaning of this field to increase the supply of scrap available.

Present conditions tend to produce a shortage of scrap in years to come by diversion of the destination of new steel under war conditions. At present millions of tons of steel in supplies and munitions are being shipped to the

war zone, going out of the country. This steel is being obtained for war purposes at the expense of much tonnage normally sold to domestic manufacturers for use in this country.

From this tremendous tonnage there will be no scrap return, unless it be bought abroad and imported, a process that seems likely to be too expensive to follow unless the shortage here becomes sufficient to make it worth while.

For every ton of additional steel shipped out for war purposes, the future will face a shortage of a ton of scrap that else would return in the course of time to be made over. In the case of some materials, this return would be in a year or two and in others it would remain in use many years, but all steel retained in this country is potential scrap to become available at some future date. Once out of the country, its possibility of return as scrap becomes remote.

The effect of this situation is to promote a general reduction of available scrap over a period of years. The longer the war calls for exportation of tremendous tonnages the greater this curtailment will be and the longer its effects will be felt.

In the production of the exported steel thousands of tons of the available scrap now in the market will be lost, adding to the probable shortage in future years.

Some exportation of scrap takes place as such, this adding to the drain on supplies in this country and making the supply of the future much less than would be the case were all steel consumed at home or exported only in ordinary tonnages. This situation promises to assume

great importance as the war goes on and more and more reliance must be laid upon new iron from ore instead of a combination of scrap and new iron, as at present. This will have a tendency to disarrange the usual balance of production between pig iron and steel and to limit the total output except as enlarged smelting facilities are provided.

Importing and exporting of steel and iron scrap material would seem to be an unprofitable financial proceeding, and the casual observer probably would not think of this material as a subject for shipment between countries. The fact that considerable tonnages are sent out of this country and other tonnages brought in is simply another proof of the importance of this trade to the industries of the world.

Government reports on imports and exports show that the tonnages of scrap crossing the borders of the United States, both inbound and outbound, are increasing from year to year, war conditions apparently bringing greater activity. Imports for the 12 months ending in June for the past three years, with the values, are as follows:

	1915	1916	1917
Iron and steel scrap, tons.	32,667	96,012	223,834
Value.....	$281,702	$1,012,927	$2,396,076

Exports for the same period, with values, are shown as follows:

	1915	1916	1917
Iron and steel scrap, tons.	29,830	157,710	237,801
Value.....	$359,199	$2,536,523	$4,764,259

Comparison of the figures shows that while the tonnages moving in each direction are not far from equal,

yet the value of the material imported is practically double that exported. Apparently the United States is paying a high price for its material, in excess of what it receives for its exports. In the absence of detail as to the classes of scrap moving in each direction, it is not possible to explain the divergence of the figures.

One of the important items of steel export since the beginning of the war has been steel axles, large tonnages of which have moved to Italy to be used instead of billets for rolling into bars. At the beginning of the European war steel axles were comparatively a drug on the market and many dealers had piles on their yards which they were unable to market profitably. Steel then was cheap and there was no incentive for rerolling mills to convert them into steel bars, though bars thus made are as good as new steel for many uses.

As soon as war conditions became outlined and it was seen that steel would be at a premium, the price on axles started to climb and from about $10 per ton it mounted to more than $40 per ton. From a drug on the scrap market they have become one of the most desirable forms of steel and are in great demand for export. That the tonnage of scrap passing the frontiers has increased during the war when space for shipments has been at a premium is a strong argument for its importance. Unless it was needed strongly, it seems certain space could not be found for its transportion and the buyers could not afford to pay the high rates for transportation by water.

Probably much of the tonnage included in this total has moved between this country and Canada and some into and from Mexico. This would be a matter of rail-

road transport and not as serious a matter as carriage by water.

The figures show a growth in three years of seven times the volume moving each way through custom houses and is a strong indication of the changes wrought by the world war conditions.

Recognition of the importance of scrap iron and steel as a factor in conservation and an aid in producing new material is given in a recent bulletin of the United States geological survey. In this publication attention is called to the fact that a large aggregate of metal material, largely iron and steel, remains uncollected on farms and in rural districts.

In sections of the country where collecting agencies have not been developed as highly as in the industrial portions, farmers have not had the fact brought to their attention that a profit worth while resides in the old machinery that litters their farms. Probably prices will not be higher than at present and the winter season offers an excellent opportunity to gather this and dispose of it at a figure that will give some "easy money".

The saving of such old scrap metal will help to meet the present serious deficiency in the supply of iron and steel. The use of the old metal will accomplish savings in coke which is now to be had only at unprecedented prices. The delivery of the old iron and steel at foundries far from iron mines and big steel centers will correspondingly relieve the excessive strain on the mines, some of the furnaces, and the railway and boat traffic in the coke and iron producing districts. The farmer who turns in his junk while the present prices prevail is likely not only

to make a clear profit over the cost of hauling and freight, but, through increasing the iron and steel supply, he is contributing to the successful prosecution of the war.

Iron and steel are needed and must be had for innumerable things—for guns, shells, ships, bridges, buildings, docks, automobiles, airplanes, rails, cars, engines, pipe, oil-well casings, etc., and for export to the allies, Italy in particular being badly in need of steel for all purposes. This is the main fact.

In the northeastern states scrap metals have long been more or less fully taken care of, mainly by the ubiquitous junk men, and along most railways and about most industrial plants they are now salvaged systematically. However, in the greater part of the United States little attention is given to saving the old metal scattered about, where abandoned binders, plows, mowers, rakes, etc., decorate the fence corners and roadsides, and discarded stoves, pumps, pipe and small utensils rust about the barns and sheds. A considerable part of this junk is already on wheels with tongue and whiffletree attached, ready in fact to be "walked on its own legs" to the freight station.

According to the census returns, there was in 1910 about $1,265,000,000 worth of agricultural machinery alone on the 6,361,502 American farms. Farm implements, not including stoves, chains, tools, etc., valued at about $165,000,000 are sold annually. A considerable part of the cost of manufacturing this farm machinery lies in the metals used, and the metals include not only iron and steel of various grades and values, but occasional small parts of brass or copper.

EXPORTING AND WAR LOSSES

Most binders and mowers have one or more bearings lined with babbitt metal containing tin now worth about 60 cents and lead worth 10 cents per pound. On the whole, excluding the metals used in railroad construction and transportation, or in city engineering and building, by far the greater part of all the iron and steel produced in this country in normal years is shipped out to the farm.

The farmers have many hundreds of thousands of tons on hand; the prices are unprecedentedly high; the country needs the metals. From the economic standpoint, it is a question of profitable thrift; of relieving in part the shortage in the metals, of conserving the iron ore and coal in the ground, and of service to country.

CHAPTER XVII

Organization and Price Regulation

With so large a number of concerns engaged in the handling of scrap, some have proved untrustworthy, as is natural while human nature remains as it is, and grave evils have arisen from time to time. Dishonest practices have been resorted to by sellers at times and much trouble has been met as a result.

Not only have sellers done things not sanctioned by honest principles, but buyers likewise have used shark methods on occasion, to the loss of the dealer. To the credit of the industry it must be said that in the great majority of dealings the scrap trade is as honest as most others. But some evils were so flagrant that the better element has sought by organization and education to minimize the dishonest dealer and to discipline the dishonest buyer.

To this end a series of allied organizations was formed a few years ago under the general name of the National Scrap Iron and Steel association. This had branches in Philadelphia, Pittsburgh, Chicago, Cleveland and other cities. Its declared purpose was to put the business on a higher plane by restraining dealers who used sharp practices and to protect members and others from wrongs inflicted by unprincipled buyers.

Much good was accomplished, but with the new problems of the war and heavy demand this was succeeded by the American Board of Scrap Iron Dealers. This has

organized branches in the principal scrap centers, made up largely of those who were members of and active in the former organization. The office of the secretary-treasurer is located at 509-511 Widener building, Philadelphia.

This board has attained general recognition and has formed the bureau of iron and steel scrap to aid the government. It is associated with the American Iron and Steel institute, the American Railway association, the Eastern and Western Bar Iron associations, and the American Board of Scrap Iron Dealers.

The main object of this board is to reduce the number of cars under load with scrap. This can be accomplished in large measure by reducing the number of rejections by insisting upon proper scrap being shipped on the part of the dealer and prompt acceptance by the buyer if it be according to specification. The board purposes to secure quick disposition of cars where rejection is just and insist upon prompt acceptance if unjust.

Other activities will be devoted to relieving congestion through embargoes resulting from too heavy shipments to a single point. Better distribution will be obtained in this way.

It has been provided that when disposition of the contested car is not made in 48 hours the board will take up the case and act promptly, assessing a penalty of $25 against the shipper if the rejection be found justified. Doubtless the board will find other avenues of activity, but accomplishment of this end will be well worth its efforts, for the benefit of the trade as well as of the country and the railroads.

SCRAP METALS

Maximum prices on iron and steel scrap originally were fixed by announcement by President Wilson on Nov. 5, 1917, as follows, on the basis of f.o.b. consuming point: No. 1 heavy melting steel, $30; cast iron borings and machine shop turnings, $20 and No. 1 railroad wrought $35.

These prices were based upon recommendations by a subcommittee on scrap iron and steel, appointed by the committee on steel and steel products of the American Iron and Steel institute: Chairman, Eli Joseph; secretary, W. Vernon Phillips; Joseph Michaels and Samuel Deutsch. Although these prices were not established as a result of any legal processes, they were held binding upon the iron and steel industry by reason of the price agreement existing between it and the government.

Although the prices established by announcement of the President as of Nov. 5, 1917, were regarded as base prices that automatically would regulate prices on other grades of scrap, they did not prove satisfactory. An attempt to meet the demand for a complete schedule was made later by the American Iron and Steel institute. The schedule which it announced on Dec. 27, 1917, however, left much to be desired. As a result of general protests with regard to numerous provisions in this schedule, the American Iron and Steel institute about Feb. 1, 1918, appointed the following new subcommittee on scrap iron and steel: Chairman, W. Vernon Phillips; secretary, C. A. Barnes; John C. Brown; Charles Dreifus, Walter C. Ely, Benjamin D. Fuller, Arthur S. Hook, Eli Joseph, Charles E. McKillips, Joseph Michaels, T. E. Moritz,

J. S. Pendleton, D. C. Schonthal, H. B. Spackman, Rodney Thayer, W. M. Tobias.

This subcommittee, which represents producers, dealers and consumers of the various grades of scrap, took up the subject of prices in detail, holding several all-day sessions in New York. As a result of its recommendations, the American Iron and Steel institute, on Feb. 21, 1918, announced an amplified price schedule. presented in the appendix. Later this was subjected to a horizontal reduction of $1 per ton.

A feature of the first schedule announced by the American Iron and Steel institute was the inclusion of a provision permitting consumers to pay to dealers a buying commission of 3½ per cent a gross ton. The announcement of Feb. 21, however, did not carry such a provision, so that since that date there has been no authority for the payment of purchasing commissions. This feature of the latest price schedule has been a source of much complaint on the part of dealers and consumers since it has served greatly to restrict the volume of business. Under the maximum price schedule, the only opportunities for profits to dealers, of course, are offered when the market is weak and prices are below maximum.

The commission of 3½ per cent was reinstated in May by the war industries board. The ruling allowed dealers to make such a charge to consumers for their services, making the cost of scrap to the consumer 3½ per cent above the maximum. On direct sales from producer to consumer the commission was not to apply.

Among many scrap dealers the impression prevailed that contracts calling for deliveries of scrap after March

31, were not subject to revision in accordance with government prices to prevail after the date. That this belief was in error appears to be indicated by the phrasing of the announcement which was made by authority of President Wilson, Dec. 28, 1917, in reaffirming prices as of Dec. 31 to prevail over the first quarter of 1918. This announcement contained the following provision: "No new contracts calling for delivery of any of said commodities or articles on or after April 1, 1918, are to specify a price unless coupled with a clause making the price subject to revision by any authorized United States government agency, so that all deliveries after that date shall not exceed the maximum price then in force, although ordered or contracted for in the meantime."

CHAPTER XVIII

Financing and Abuses

For the most part, in fact, almost entirely, attention has been given to the material side of the scrap industry in the preceding pages. Gathering, preparing, selling and using scrap have monopolized the attention of the reader. These are the features that stand out most prominently to the ordinary observer.

But there is another side of much importance and of great interest. This has to do with the financing of the business. In an industry that handles probably 15,000,000 tons of material a year, with prices now ranging from $20 to $50 a ton, it will be seen that the money involved runs into immense sums in the aggregate. Since most scrap passes through the hands of at least one middleman every ton represents at least two transactions, doubling the money really involved.

It is a business of quick turnover, scrap being on the move with little hoarding or storing. When it is loaded by the producer or the dealer who collects it from varied sources, it usually moves as quickly as the railroads can handle it to the consumer, perhaps with a reconsignment. It is likely to be shipped to a dealer in one of the big centers and he sells it before it arrives, changing its destination en route and then it is diverted to the consumer.

In the case of country mixed scrap, it goes to a yard to be sorted and prepared and then is loaded for final disposition. But in few cases does the scrap remain idle

after it once has entered the whirlpool of the market. One reason for this lies in the fact that demurrage charges on scrap allowed to remain overtime in railroad cars eat into profits. It is equally expensive to unload and reload. So it comes about that the dealer moves his material as rapidly as possible, cleans up and is ready for the next transaction. A large dealer has numberless deals overlapping at the same time.

Then, too, usually a dealer seeks to sell as fast as he buys to avoid a change in the market. A safe and certain profit is more to his liking in most cases than the possibility of an upward turn that may increase his profit, for there always is the possibility of the change being against him. It is a touch-and-go business in this respect, though some operators play the market much the same as in grain and stocks, selling short and going long when conditions seem right. This sort of dealing brings some unusual rewards in many cases and some unexpected losses in others.

Usually scrap is bought by dealers on a cash basis, paying for it when bill of lading is received. It is sold to consumers on a basis of net cash in 30 days after delivery. Thus the shipment must be financed for the period it is in transit and for 30 days after it is accepted. In ordinary conditions of the market there is a constant inflow of money from sales to pay for new purchases and the net investment may not be as large as the volume of tonnage would indicate.

In the freight tieup following the blizzards of January, 1918, shipments of scrap already paid for were snowed in and some were on the road for weeks, the dealer owning

them thus having his capital tied up unproductively for a long time. He could not realize on the shipments until they were delivered.

In some cases where steel mills buy large tonnages from several dealers deliveries are made faster than the mill can receive and unload them and an embargo is declared against further shipments. The dealer who has bought for this delivery then has to seek another outlet for his tonnage or pay demurrage on the cars thus held up. This gives him a lessened profit or a loss, depending on the length of time the embargo is in force.

Probably few lines of business present a situation that from a credit point of view parallels the scrap industry. Few lines of business are so safe from the credit side and yet few meet such constant losses. It has few failures in its ranks, and probably no other such important industry has so many successful operators who have no formal business training. Native shrewdness serves well in its stead. Yet this should not be construed to mean that there are not a majority of well trained men in the scrap business. However, the less educated man often makes an equal success with the better educated.

Inspection of a mercantile report on a scrap concern discloses the fact that only a small fraction of its capital is invested in the things about which a credit man concerns himself most—machinery and equipment. These ordinarily form more or less of a burden to their owner. Their actual cash value is always questionable and uncertain, depending solely upon business or trade conditions.

It is a fact that a manufacturer of any specialty finds it difficult to fix a dependable figure as the liquidating

value of his equipment. His partiality to his business would make him tend to place its value higher than a forced sale would realize. A plant with equipment valued at $1,000,000 is worth that much as a going concern. Should the business become unprofitable and liquidation become necessary, the equipment would bring probably only 25 to 50 cents on the dollar of valuation in ordinary times. The figure would depend upon its general usefulness or prevailing business conditions at the time of sale.

This is the almost invariable result of passing any article of merchandise through the hands of a second party, as owners of automobiles know when they have sold their old cars.

This question of solvency is not usually a feature, because even those concerns engaged solely in yard business have little of their capital tied up in equipment, compared with the capital invested in the business itself. The ratio of actual capital to that invested in equipment is larger because the carrying on of business requires a large fund. In fact, it is almost safe to say that all the capital invested in a scrap business is employed in the actual turnover. It is in constant actual use, being circulated and actually working.

It is invested in a cashable and salable commodity. Scrap always can be sold because there always is some use for it, even in periods of poor business. In a way it is as staple a commodity as common articles of food. This makes the scrap business unusually favorable for the extension of credit with small risk of loss on the part of the lender.

FINANCING AND ABUSES

Although occasional failures occur among scrap dealers, it is a fact they are much less frequent than in almost any other line. This statement will be borne out by examination of the reports of any commercial agency. The failures that do come about usually are the result of factors outside the scrap business proper. They are caused mostly by extension of activities into other lines of business, with insufficient knowledge, resulting in mismanagement and eventual financial embarrassment.

It is safe to say that so long as a scrap concern devotes its resources to the scrap business itself and does not attempt to operate in something else the chances of financial wreck are remote. This is corroborated by the terms of credit existing in the scrap business and the lines along which dealing is done.

Scrap trading is divided into two parts—buying and selling—equally divided, since everything that is bought must also be sold. Each division represents a separate problem, for the dealer must use every endeavor to buy in the cheapest market and on the best terms obtainable and to sell in the highest market and on the best terms he can obtain from the consumer. His skill in these two endeavors spells his financial success.

Scrap is bought by dealers in two ways. It is paid for in full or on the basis of 75 per cent of the price on receipt of bills of lading or other proper shipping documents. The remaining 25 per cent in the latter case is remitted when returns from the shipment have been received by the dealer from the consumer.

The consumer usually pays for his scrap on the basis of 30 days net cash. Full cash with receipt of bill of

lading usually is insisted upon by railroads and industrial concerns. This matter will be taken up at some greater length later in this discussion. The 75 per cent terms are those usually made among dealers and brokers themselves.

Just how these terms work out may be illustrated simply. Assuming for the sake of illustration that a scrap concern buys half its tonnage from railroads and industrial concerns and the remainder from dealers and brokers. On purchases of same grade of scrap from both sources, valued at $20 a ton, paying in the one case full cost and in the other case 75 per cent of the cost, there would be an immediate investment of $35 in two tons of scrap, an average of $17.50 a ton. This may be sold to a consumer at $21 a ton, giving a return value of $42 for an investment of $35. This gives an actual investment of 83 per cent, leaving 17 per cent of the return on the ten tons as a payable balance on the remainder owed on the one ton which was only partially paid for. In this also is the brokerage profit.

As there was no investment until shipment had been made the investment was an actual equity, as good as any first-class investment, bond, mortgage or stock. Assuming that the consumer to whom it was sold was financially responsible, it is evident that a loan of capital to the concern handling this deal assumed little risk because the borrower operated on what could be called a margin of safety of 17 per cent.

Assuming that a broker pays all cash for his scrap, he still has a safety factor in the difference between his purchase and sale price and the equity is the same. A

profit has been assumed for the broker but even if he were unable to realize a profit on account of a downward change of price before he was able to make a sale, the loss would not be a large percentage of the cost of the scrap. It could not wipe out his cost entirely because scrap prices do not fluctuate to such an extent.

As there are few inexperienced scrap men in the business, most dealers would get out of the deal with a loss of only a few dollars a ton at most. If his creditor was forced to close him out the loss to the latter would be small in proportion to the loan, the greater part of which would be realized. In most other lines of business a failure brings a large depreciation on the plant and equipment, to say nothing of the losses on other features of the business. As was pointed out previously, so little actual capital is invested in equipment there is small margin for loss in that respect and the scrap owned at the time of the assumed failure always can be marketed at close to its cost, giving a large percentage of return to the creditor.

The personal element ranks as an important part of most lines of business and it must be admitted that this is not an asset that can be converted into cash. It is not an actual equity. In the scrap business the human element has relatively little importance, from a financial point of view, because the business is confined, as already has been stated, to merchandising in commodities possessing actual salable or cashable equities.

Even if there be mismanagement or improper handling of business, results cannot be as disastrous as in most lines of trading. In other words, the risk or possibility

of loss is not relatively as great, since the proportion of basic value is much heavier than in most other lines of business.

Exceptions are found where concerns speculate incautiously and buy or sell in too large quantities and without due regard to their facilities and thus come to grief on a quick turn of the market. But these cases are rare and trading seldom is carried to the danger point. This is proved by the fact that failures of scrap dealers are in small proportion to the total of commercial bankruptcies.

Most scrap dealers are experienced and when it is necessary to take a loss they meet the situation philosophically, as one of the features of a business which must have some unprofitable deals.

People familiar with the iron and steel trade know that more expected profits are lost in the scrap trade than in any other department. This is not an alarming statement since they are incidental to the business itself. They are expected and are met without regret as inevitable to conditions surrounding buying and selling. They are a natural sequence to a business in many respects primitive and fundamental.

The successful operator must take chances in dealing in old material which are not necessary in other departments. But conditions that cut into or absorb expected profits in one deal will give a profit in another. The field is immense and possibilities are so great that profits in the long run far exceed losses.

One of the inevitable sources of loss is rejection of shipments because of improper classification, by shortage

in weight and reductions on other accounts. These represent an evil which has caused much thought, and efforts have been made along various lines to correct them. Some progress has been made but much remains to be accomplished.

The dealer buys from railroads and industrial concerns subject to their weights and sells to consumers subject to their weights. The discrepancy that sometimes exists is beyond belief but the dealer is between two fires and must assume the value of the shortage, which comes out of his expected profits on the shipment.

Probably it has happened that the difference in weight sometimes has been to the advantage of the dealer, but ordinarily it is against him and there is no possibility of his avoiding responsibility.

Other sources of loss also exist, inherent to the trade, and were it not for these drawbacks the industry would profit amazingly. As it stands, the financial reward, as a general rule, is great and the most successful operators pile up fortunes, while the modest operator with small capital and a conservative business is able to gain a reward that well repays his efforts.

Buying and selling of scrap subject to the respective principals' weights governing, to which reference was made recently, seems inconsistent and in a degree unfair to the scrap broker. He usually makes a purchase and sale on small margin, to give him a reasonable profit, without allowing anything extra as protection against losses from discrepancies in weights.

When a shortage develops and is reported to the seller his claim is declined on the ground that he agreed to

accept the seller's weight. When he seeks reimbursement from the buyer his claim meets a like fate. It is a case of "passing the buck", the effect being to warn the broker to take possible losses into consideration before buying or selling. In this stand the principals evidently forget that the prices at which the broker handles his goods are not established by him but by themselves, the product of market conditions.

The scrap dealer never has been able to understand this situation. He finds that most of his customers, both buyers and sellers, are intelligent and honest and usually fair minded. Yet when it comes to the decision in matters of vital importance to him, on which his profits depend, he is shown no consideration, notwithstanding that both sides know his position is that of an intermediary and that he must pocket the loss himself.

This cannot be considered a healthy condition of the trade and when a scrap man is criticized for certain sharp practices he defends himself by saying they are necessary for his existence. He claims that if he did not take advantage of certain conditions he could not remain in business.

From a nonpartisan point of view, there seems much truth in his argument and he never has found other means of protecting himself effectually against these losses in buying and selling. That he takes an offered advantage to recoup himself is no more than natural.

A new feeling is beginning to appear in relation to this abuse and the broker is being given more consideration in matters of disputed weights. The wider recognition is given this matter the sooner this and other evils will be

eliminated. Movements now are on foot to protect all parties to scrap trading from the ill effects, and a new day is in sight, not far distant. Broad minded men in the trade realize that the usual attitude taken by buyer and seller is a bar to progress and that sooner or later the arbitrary stand taken by buyer and seller against the broker must be handled differently.

It is a fact that virtually all concerns operating their own track scales, manufacturers, railroads, dealers and the consumers, are members of the standard weighing association. Yet neither side usually will accept the discrepancy. A change in attitude is one of the reforms toward which progress is being made.

The scrap broker points out that in cases where he is not concerned, that is, in the sale of new material, discrepancies are handled in an entirely different way. If there is a shortage in a shipment of new material from a mill, where there is no intermediary, a compromise is made or the weights of one or the other principal are accepted. It is difficult for the scrap man to understand why this plan cannot be applied as well in his case.

Some consideration of possible corrective means to settle the disputes arising over discrepancies in weights seems timely. It is known that in some European countries inspectors are appointed by agreement to check weights and classifications at destinations and the decision of these inspectors is binding on all parties to the transaction.

This seems a simple way of covering the situation and avoiding many unpleasant situations. Such a provision would stabilize the matter of weights and grades, give

much smoother operation and do away with much waste motion. Such a system would be vitally useful at this particular time when railroad resources are being taxed to the limit, and would release much needed car equipment, as delays now caused by grade and weight disputes would be eliminated. As it is now, cars are held while attempts at adjustment are being made, while under a system of inspection they would be unloaded and released at once.

The cost of such a system would be scarcely noticeable and well worth while in the improved conditions that would result. A flat charge of 50 cents on every car shipped by all dealers would be ample, and this would not be noticed by the trade. As soon as the disputes were eliminated, the charge could be made less, as there would be less for the inspector to do.

Efforts along this line have been made but never have come to success. The movement, however, is worth while and seems destined to meet success finally. Some concerns might object, perhaps, but the majority probably would see the advantages and support the movement.

Legitimate deductions impose sufficient burden upon the scrap dealer but weight discrepancies fall outside the pale, and one weight or the other must be wrong and should be righted. Grading rejections sometimes are based on pure technicalities and then are without justification, while in other cases the shipper is at fault in his representations. Occasionally overweights are met and some consignees give credit for these, while others take

advantage and say nothing. Inspection would cover this as well.

The occasional dishonest practice imposes a burden on the honest buyer and seller, since the industry as a whole must bear the losses thus sustained.

While it is a debatable point, like the query as to whether the hen or the egg was created first, scrap dealers claim that most sharp practices on the part of the scrap dealer or yard are actuated by unfairness on the part of others, for which a balancing advantage is sought. Inspection would penalize all the wrongdoers, no matter what side of the transaction they occupy.

Under these circumstances no valid objection can be laid against the project of a standard weighing and inspection system, the honest dealer and consumer being the gainer by the elimination of abuses that have been a thorn in the side of the business, while those who may have sought a profit by dealing less honestly should have the opportunity removed from their path.

Much thought has been given to this matter for many years as the losses met from unjust weights and grading have been severe and the losers have smarted under their inability to protect themselves. With this removed from the trade it will assume a much higher plane than is possible now, and the fly in the ointment will be removed.

The matter of terms on which trading in scrap is done is an important feature of the business since it supplies the means by which the dealer is able to maintain his volume of transactions without involving an undue capital.

As has been stated previously there are two bases of terms: Cash on bill of lading or 75 per cent on bill of lading and balance net 30 days. The former usually is stipulated by railroads and some industrial concerns and the latter by brokers and dealers in transactions among themselves. Terms on sales to the consumer invariably are net cash 30 days, although in some instances a discount of one-half of 1 per cent or 1 per cent is allowed for cash in 10 days.

A broker dealing with other brokers or dealers on terms of 75 per cent cash can do a large volume of business on small capital, compared to the total he handles. For instance, on a car of 40 tons of scrap at $25 a ton, a total of $1000, he presents his invoice to the buyer and receives $750 at once, the remaining $250 being his only investment and that for 30 days. On four cars of this size and price he would have an investment of $1000 on business totaling $4000. He has paid $750 on each of the cars, which he receives at once from his buyer, and he is not compelled to pay the remaining $250 for 30 days, his buyer reimbursing him approximately in the same period. Thus, leaving out of account the profit from selling at a higher price, he really has no investment in the transaction beyond the few days equivalent to the time he needed to complete the transaction.

Thus, on his $1000 investment he can make four purchases and four sales, involving 320 tons of scrap, a total of $8000 involved, before his capital is entirely tied up.

In such dealing the broker must sacrifice part of his selling price because he sells to another middleman

instead of direct to a consumer, his profit being divided and smaller than would be the case otherwise. If he made a profit of 25 cents a ton on each purchase and sale, a total of $8 a car, his gain would be $32, or 3.2 per cent on the $1000 invested. Figuring his profit on the basis of the $8000 involved it would be only 0.4 per cent. From this it will be seen that the large houses, doing business on a variety of terms—cash, part cash and time—make a small margin of profit on the gross business, the gain being sufficient only because of the large volume handled.

Buying on cash or part cash terms and selling on time necessitates large capital, as will be evident from the above example. As a result brokers are large borrowers, obtaining money on time notes, usually 60 to 90 days, at 5 to 6 per cent interest, depending upon the condition of the financial market.

Their assets being readily accessible and easy to liquidate, a strong concern is a preferred bank customer. This is especially true at present, since the scrap dealer's accounts are with concerns engaged in an industry all branches of which are on a highly prosperous plane and therefore are preferred risks.

Scrap dealers find little difficulty in obtaining bank credit accommodation, and large sums are constantly out on loans to move the tremendous tonnages of scrap which are necessary to supply the nation's industries. The money is t u r n e d quickly, obligations are taken up promptly, the possible margin of loss is slight and the security of the best.

Since classifications of scrap have become standardized to a great extent, at least so that the market in general knows what is meant by any given term, trading in scrap has been a much simpler matter than formerly.

Yet there remain some instances where excessive specification interferes with free trading, mills or other consumers being overly particular about the material they will accept. This results in various untoward situations. Scrap men claim that these refinements of specification are adhered to as an excuse for rejections if the consumer is not in great need of material.

Occasions have arisen when material of a grade usually accepted by the consumer, especially in times of shortage, has been turned down under the specifications of the mill in a period when scrap has been plenty. This practice has resulted in loss to the dealer who followed past practice only to be faced by a rejection when he least expected it. He has no recourse except to make a concession in price or find another buyer, paying demurrage and added freight charges as well as being forced to sell as quickly as possible and usually at a lower price. The effect upon the market of these forced sales, usually is to depress it further, usually coming at a time when scrap is plenty and prices are declining.

When scrap is scarce, dealers offer their material preferably to consumers who do not follow such a practice, leaving the particular buyer and the one who rejects under such circumstances until after he has tried other buyers. This restricts the opportunity of these mills to buy, as compared with the ones that deal more fairly. This sort of practice has grown much less in recent years

and probably will disappear entirely as the business develops.

The criticism of such practice is that it is not followed steadily, material of the same sort being accepted at one time and rejected at another, leaving the dealer at sea as to what he can expect. It is not a matter of bad practice on the part of the dealer, but rather it is a mistaken policy on the part of the buyer.

On the other hand instances are met from time to time where a shipment of scrap is "plated," objectionable material being placed on the bottom of the car, with a layer of good material on the top, to deceive the inspector. Once past inspection and acceptance, the dealer figures he is safe and his profit is large, if he can put it over.

Probably few cars are found where a small quantity of inferior scrap is not mixed with the better grade, but this small quantity is not sufficient to cause rejection and the profit to the dealer is not large, except that he can thus dispose of several tons of cheaper material in a number of cars and in the long run make a fairly large gain over his return should he have sold the poorer car entire.

The better element of the scrap trade, and it is by far in the majority, is up in arms against "plated" cars, and uses every effort to prevent this practice. It is so glaringly dishonest that it is not resorted to by many dealers and it soon carries its own punishment in practical boycotting of the one who follows the practice.

Probably these two practices, one on the one hand and the other on the other, are an offset. Both would better be eliminated for the good of the trade, and instances are growing less as time goes on.

Office and clerical work of the scrap broker's office deserves some mention because of its unusual features, arising from conditions within the business. As a result of shortages and deductions, there is more detail work connected with the bookkeeping of this industry than of any other raw material business.

In most other lines, entry of an invoice on the books disposes of the item it covers and payment is received as charged. This is not the case in the scrap business. Buying according to the seller's weights and selling according to the buyer's weights, the same applying to grading, means much work on the books because of shortages and deductions resulting from difference in weights or improper grading. Demurrage on cars and freight charges also enter as factors to be added or deducted on the original entry and few cars are paid for without some change being necessary on the records as first entered.

As each car of scrap represents two transactions, a purchase and a sale, and each shipment involves a consignor and a consignee, the bookkeeping is necessarily double. This increases the detail work to a great degree. In periods when business is brisk and material is changing hands rapidly the strain is heavy on the office force, because of the multiplicity of detail that arises.

Some of the best clerical workers in the business world are found in the offices of scrap concerns, as unusual intelligence and experience is required. If an employe is not alert and attentive to the interests of his employer much money can be lost.

With demurrage charges much increased at present and much scrap handled on consignment, the book work

must be done without delay to avoid heavy demurrage charges. As a rule employes in offices are better paid than for similar work in other lines. This is a result of the unusual demands made on them by the peculiar intricacies of the business.

One feature of the large scrap concern's organization is a traffic department, to avoid mistakes in handling shipments and to trace and keep record of cars. This is an important feature which pays for itself many times. Proper disposition of shipments and proper routing to avoid switching charges as far as possible save time, and time is money to a large degree when applied to shipments of scrap. Frequently lack of definite routing to take a car to the proper delivering railroad may result in loss of time and the imposition of an unnecessary switching charge before it can be delivered to the buyer.

In the traffic departments of scrap dealers are found men possessed of the most intimate knowledge of rates, routes and customs and ability to handle tonnages in the most direct way. It is not sufficient to have a car of scrap delivered in the city where the consumer is located. It must be routed to bring delivery on the road that serves his plant so that it can be placed on his siding and unloaded direct. This requires knowledge of the service possessed by every consumer in the concern's field, as well as of the railroad situation in general.

Taken as a whole the office work of the scrap dealer is highly specialized and requires a high degree of skill to transact it successfully and with a minimum of loss.

CHAPTER XIX

Sidelights on Trading

Probably no other department of the iron and steel industry presents such an open and natural market as does scrap. No one ever has heard of a scrap "trust" and no combinations ever have been formed successfully to "corner" or manipulate the situation. In some large centers, scrap firms have become strong in a business way and can dominate the situation to some degree; but it is impossible to obtain a position where all other dealers do not have an equal share in the benefits offered by the market.

This is because collection, preparation and sale of scrap can be carried on with comparatively small investment for a plant, making it a far different proposition from a manufacturing business. Collectors of scrap can carry on business successfully and make money without any equipment and without a yard or even an office, though these do not handle much business. From that possibility to the concern with large offices, a force of clerks, expert buyers and sellers, a well equipped yard and a large bank account and credit, there are all grades of dealers.

Any man may enter the scrap business and try his hand, although he will not succeed without considerable knowledge of the game. Many instances of large business started on a "shoestring" of actual investment,

but determination and knowledge that won success, are known in the scrap industry.

Consumers for the most part are willing to buy from any person offering scrap, provided he be reliable and will deliver the material as contracted. Some concerns prefer to deal only with dealers having large resources and the ability to contract for large tonnages in one transaction and keep the shipments arriving steadily as they are needed. But these are comparatively few, while the buyers willing to take material from whoever offers it greatly outnumber them.

Often the small operator is willing to turn his material quickly for a small profit to avoid a possible loss in a quick turn of the market, and there are always buyers ready to seize a bargain and take in this material at the lower price.

There are thousands of collectors of scrap and hundreds of dealers who gather in the collections and unite them into large tonnages or sort and prepare them. The business is spread out fairly thinly over the entire country and affords little opportunity to any one person or concern to monopolize it.

This fact makes it difficult to prevent hoarding of scrap in times of low prices. Many instances are known of collectors in small centers buying up scrap iron and steel through a period of years and keeping it for a higher market until they have had their entire resources tied up in a stack of discarded material. Occasionally forced sales have given a loss, but in numerous cases a high market has come with the swing of the market pendulum and a heavy demand. The collection has been mar-

keted many dollars above its cost and the collector has cleared a fortune in a few weeks by hanging on until the market was right for him.

This practice has its use in preparing a reservoir of material in smaller centers during dull periods to be tapped for thousands of tons when demand comes with quickened business needs.

This was the case at the beginning of the European war in 1914, large collections of scrap having been made through the dull years preceding. When mills began to need large supplies this was drawn upon at increasing prices, and gradually the accumulation was tempted forth by successive increases until it was practically exhausted in the course of about two years. Since that time it has been marketed promptly and no hoarding is going on. When the next dull season appears, the practice probably will be resumed.

Consumers of scrap iron and steel have varied buying methods, but two schools of buyers exist who operate on widely different plans. Each considers its methods of buying the better and perhaps each is right from its own point of view.

One of these might be called the opportunist. He is always in the market for bargains and can be relied upon always to take any tonnage offered of the grades he uses, provided the price is attractive compared with the general level of the market. He is a sure haven for the unfortunate dealer who chances to be caught with a carload or two he must move quickly or meet a loss. By this means he is able to keep up his reserve and maintain a low average cost. He is regarded highly by the

trade since he presents the opportunity for a true bargain, relieving the seller from the burden of a bad situation and at the same time obtaining a benefit himself. Of course, it is not always possible to obtain one's entire tonnage in this way, but considerable raw material can be bought in the course of a year under this plan at advantageous prices.

The other class of buyers come into the market quietly for a large tonnage at one time. An inquiry is sent out to about a dozen large dealers for perhaps a tenth of the total tonnage desired and bids are received. Then, after some dickering, perhaps each dealer is given a contract for the entire tonnage on which each was asked to bid and the aggregate thus covered is much larger than any dealer had expected on the basis of the inquiry submitted.

The effect of this sort of buying usually is to give the market an upward boost for the next buyer. If the campaign is well worked, the large buyer may have obtained his large tonnage in small lots at much less than would have been the case had the entire tonnage been asked in one inquiry.

Often in this sort of buying dealers sell short, agreeing to deliver material they must buy in the open market later on; and if the total tonnage bought is sufficiently large to raise the price level, this buying is difficult except at a loss.

Sometimes in a campaign of this sort the trade finds out how much the total tonnage aggregates, and the later rise is anticipated in the quotations submitted to the buyer who thus loses the benefit of the present level.

The latter method, of course, can be followed by only a few consumers, whose capacity is sufficient to handle large tonnages, and the ordinary consumer is forced to buy on a different plan as his needs are so much less.

As a rule, consumer and seller are in fairly close touch, each specializing to some degree. The seller knows his market and has a general idea at all times where he can dispose of a tonnage he may have available, while the buyer keeps in fairly close touch with the sources of supply and knows where he can turn for material when he needs to replenish his reserve.

Three classes of men are engaged in handling scrap, though the lines are not closely drawn and any person or firm engaged in the business may come under two or three of the divisions.

The divisions are broker, dealer and manufacturer. The larger class is the dealer. He buys scrap from any source and sells it to any consumer, but the scrap is actually his property in the transaction and he takes his own loss or makes his own profit, the same as any merchant in any line of business. Viewed as a dealer only, he does not sort and prepare scrap but handles it in the form in which he buys it. Often he does not see the material that passes through his hands, taking it in carloads from railroad, manufacturing plant or collector and ordering it shipped to the consumer direct. Often he sells what he has already bought and has in transit and often he sells what he expects to buy later to fill the order. The latter is called "short" selling.

The broker is a comparatively small class, but he does exist to some degree. The broker is a go-between who

finds a seller for a buyer or a buyer for a seller. He does not buy or sell, but simply arranges a sale between others and for this charges a commission on the money involved in the turnover. A consumer unable to find the scrap he needs, or without time or opportunity to look for it, engages the broker who searches out a supply and arranges the sale. Sometimes a producer asks the broker to find a buyer for scrap he has not the time to market himself.

The manufacturer usually is also a dealer but sometimes he is a consumer as well. He takes the raw scrap and by shearing, breaking, sorting and classifying, adds to its value by putting it in the form the consumer desires. In this he is as truly a manufacturer as anyone who takes raw materials and turns out a finished product. If the scrap is his own, he makes whatever profit he can in the transaction since it is his own property and he is entitled to all the value he puts into the material. Sometmes he does this service for other owners of scrap for a fixed payment, based on the labor involved.

As has been pointed out previously many consumers, particularly steel and iron mills, buy raw scrap which they prepare for their own use, making a profit by the transaction instead of paying for the service as would be the case were it performed by others.

By far the larger class is the dealer. He may act as a broker for some client under unusual circumstances, although the larger dealers seldom do this, having sources of supply sufficiently large to make it safe to assume the transaction themselves instead of merely arranging the deal between the others. The dealer also usually is a

manufacturer, as all who do a large business have more or less well equipped yards for handling material that is not ready for use in its existing form.

Yet, in spite of this variety of classification among handlers of scrap, circumstances often arise which cause direct selling by producers of scrap to the consumer. This usually occurs in times of great scarcity when consumers search out sources and contract for the accumulations of certain producers, thus cutting directly across the situation and eliminating the dealer and broker entirely. Exchange contracts, previously explained as existing from time to time, also eliminate the middleman and cause scrap to be handled direct instead.

CHAPTER XX

Sensitive Market in Scrap

Buying and selling scrap iron and steel is much like a wrestling match, in that first one contender for advantage has the upper hand; then the situation reverses and the other holds the key to the situation. Sometimes these changes are so sudden as to be bewildering, and both buyer and seller must be constantly on the qui vive to note the change and discount it if possible.

In the terms of the trade, there are conditions that make a "buyer's" market and a "seller's" market. It all goes back for a basis to the fact that scrap dealing is entirely a matter of supply and demand, as has been noted in this series of articles previously. If consumers remain out of the market and dealers have material to move, the market is a "buyer's" market, since the initiative lies with the seller, and the buyer has the advantage and can dictate terms in exact proportion to the necessity the seller has for getting rid of his material.

If, on the other hand, the consumer is in need of material, the advantage is with the seller and it is a "seller's" market. He can ask higher prices in proportion to the probable supply and the need of the consumer.

Inasmuch as scrap dealing is largely of the "spot" variety, and differs from the selling of manufactured products in which contracts may be made for future delivery extending over many months, quick turns are more likely to happen. It has been known recently to come about

that a seller's market, with many consumers inquiring and the holder of scrap holding out for a high price, has changed over night into a condition where practically all the consumers have withdrawn and ceased to ask for material. At once prices come down, and some holders seek by every means to unload their holdings, fearing a slump is imminent and desiring to get from under.

It is in such situations as this that the opportunist buyer takes in tonnages at attractive prices and manages to add to his reserves at figures that keep his price average cost well down.

Odd situations occasionally come about in the market. Sometimes a dealer will bid higher for scrap than the price at which he is willing to sell the same grade to a consumer. Railroads frequently are able to sell material to a dealer for a higher price than a consumer can afford to pay the railroad, since he can buy in the open market for less than the dealer offers. Usually this results from the fact that the dealer has a contract made at a high level and needs the scrap to make delivery. He is able to pay above the quotation current at the time because his contract gives him a margin of profit even at the higher price.

Point of delivery also has an influence upon the price at which a buyer may obtain a tonnage. The matter of railroad rate and switching charge enter into the case, and a dealer with cars on tracks where delivery can be made without a switching charge can undersell a competitor whose material is subject to a further charge by the railroads.

SENSITIVE MARKET IN SCRAP

The careful dealer in scrap notes every business factor that may influence the general situation, his market being as sensitive as the stock market. He forms his impressions and often is able to discount the situation at considerable profit. He sells what he has not bought, trusting to his grasp of the situation to guide him as to the future. He believes he can buy at less than he has sold, and usually he is able to do so. Occasionally he misses his guess and loses his profit and sometimes more.

Dealers thus become bulls and bears according to their position with reference to obligations. They desire a falling market as often as a rising and exert efforts to influence the situation to serve their own ends. They have been known to make small sales at a loss in order to be able to buy elsewhere at a lower level than the market offers and make more profit on larger dealings than the small loss they sustained by underselling.

Dealing in scrap is like dealing in stocks in many respects and tips are valuable. The scrap dealer is an opportunist and he has his ear to the ground all the time to gain some inkling of what is going on that may affect the market to his advantage or disadvantage. The value of an advance tip can be figured in dollars and cents, and to know with certainty ahead of competitors gives opportunity to trade at a profit.

An instance, whether the charge be true or not, will illustrate how advance information is of value. When prices were fixed by the government the fact was known to some eastern dealers the same day, because of their proximity to the geographical point where the decision was made, while western dealers did not receive the infor-

mation for several days. The price announcement was mimeographed, and then mailed and a Sunday intervened, making mail delivery that much more deferred.

As a result of this situation many western dealers claim the eastern sellers were able to profit largely by knowing the facts sooner. This is an illustration of the possibilities.

At the beginning of the war a demand arose at once for billets for foreign rolling. One scrap man returning from Europe was told of France's immediate need for shrapnel steel at once started buying steel axles, which are as good as billets for many purposes. He succeeded in getting possession of almost all the available axles in this country and is said also to have contracted for tonnages from railroads before the axles were removed from the cars where they were serving. Inasmuch as axles had been of little value up to that time, this adventurer into speculation was able to pick them up at a low price and make an immense profit from the transaction before the others awoke to the situation.

These are outstanding examples of what is going on all the time in the scrap market in a smaller way. Every tendency of the various markets is weighed and discounted in advance by the wise scrap dealer to determine his action, whether he will buy or sell to meet conditions. Ability to judge conditions and discount probable tendencies is a most valuable asset and spells the difference between success in a large way and only moderate profit, according as the dealer is able to apply it to his business.

SENSITIVE MARKET IN SCRAP

The scrap dealer is addicted to "hunches" and often "plays" them, putting his dollars against his judgment and winning profit through his acumen.

With the possibility of quick changes in market conditions, it is necessary to keep in close touch with every possible modifying influence and to judge its probable effect. Peace talk which has its effect upon the stock market, also affects the scrap market in equal degree. Government price fixing or possibility of changes in quotations on the part of the government is an important influence, and the dealer who can get advance information or can judge shrewdly of the probable action has an advantage over his slower brother who is unable to make up his mind sufficiently to act and take advantage of the situation.

There is much psychology in scrap trading, though the dealer might not call it by that term. Judgment of men with whom he deals aids in making a deal, giving knowledge how far to press an advantage or when to cease and close the deal. It is salesmanship and buying ability carried to the nth degree and the successful scrap dealer is a real salesman and buyer, else he will not get ahead far in his business.

Supply and demand form the great force regulating the course of the scrap iron and steel market under ordinary conditions of free trading. Inasmuch as scrap has no intrinsic value and no cost of production, being waste incident to replacement or industrial processes, there is no basis from which to start estimating its value. Nothing except the need of the consumer for a given grade gives it any value. It is affected vitally also by

the price of pig iron, which it displaces in almost every instance.

Even in times like the present year, when the government, by agreement with the industry, has fixed certain arbitrary maximum prices which may not be exceeded, supply and demand has its decided effect. Where demand exceeds supply, prices have gone to the maximum and have been held there only by artificial means. When demand is slack and supply is large in a given grade, the price sags below the maximum. Thus movement upward beyond a certain level is hindered while movement downward is not affected.

In determining the maximum prices it was necessary to take into account the varied purposes for which some kinds of scrap are used. Thus heavy cast scrap, which really is simply pig iron in another shape, is used largely in foundries and also in open-hearth plants. It was necessary to specify that when this grade is sold for use in the steel mill it must not be sold for more than heavy melting steel and other scrap used in the open hearth. But for use in the foundry, where it must be broken to cupola size, $5 more was allowed for preparation, putting prepared cast scrap at a maximum of $34 a gross ton while pig iron was pegged at $32.

The result of this is to stop shipments of heavy cast scrap to open-hearth users as long as foundries will take all that is offered. No dealer will sell it at $29 for steelmaking as long as he has a market at $34 from foundry users. When foundries fail to take all that is offered, it will be possible for steel makers to obtain the excess and

the price to foundries probably will decline below the maximum.

The same result probably will follow in the case of other grades for which there is a double use, the maximum price differing according to the purpose for which the material is used.

This situation has given rise to a peculiar condition. The dealer buying cast scrap naturally will bid on the basis of the lower maximum, especially in case he is buying without having a consumer ready to take it. Thus he would seek to buy cast scrap on the basis of a $29 maximum. He might then sell it to a foundry on a $34 maximum, making a large profit. It is scarcely possible for this to be regulated to prevent such action.

To avoid this, some sellers, notably large railroads, have endeavored to have dealers specify in their bids the destination to which the scrap is to go and the use to which it is to be put. This is impossible to give in many cases, as the dealer does not know in advance what consumer will get the material, unless he already has made a sale

This effort to determine destination before making a sale adds much to the complications of the business and is a cumbersome thing to work out. Coming at the same time that other complications have arisen over commissions for handling orders and general interference with usual trade methods, it has added considerably to the difficulties of the situation.

Volume of scrap trading has been increasing in the past few years, as have all lines of business, especially in the iron and steel industry. In fact, it seems safe to assume that scrap trading has grown rather faster than

most other lines. Growth of the iron and steel business in general has been so great that it has stimulated demand for scrap beyond the proportion usually met. In other words, a proportionately larger tonnage of scrap is needed than in normal times.

So heavy is the demand for pig iron the only competitor of scrap, there is not enough to go around and the excess demand can be met only by enlarged tonnage of scrap. Labor conditions, fuel conditions, and lack of transportation have limited the production of pig iron to a degree that the supply appears to be inadequate to meet the enlarged demand for iron to make the huge tonnage of steel that is needed for war and ordinary purposes. This deficiency can be met only by scrap. The result of this is that demand for and consumption of scrap is greatly enlarged.

To conduct this great business huge funds are required for financing. Speaking roughly, the annual volume of business in scrap in this country now is about $600,000,000, assuming that it is 20,000,000 tons a year at an average value at present of $30 a ton.

It is difficult to carry on this volume of trade with present capital invested in the scrap business. Scrap concerns now are capitalized from $250,000 to $750,000, speaking of the large dealers, with few at the maximum. These large concerns are dealing at the rate of $5,000,000 to $25,000,000 or more each per year. This makes it plain that much skill and management is necessary to keep things moving properly. Large loans must be made frequently and met promptly. As many buyers make a practice of disregarding the terms of contracts under which

they have bought and delay payments beyond the date set, the scrap man has his difficulties.

This is another of the abuses of the business which it has not been possible in the past to correct. In fact, it has been true in some instances that concerns have forced the scrap seller to finance them to a large degree by withholding payments. With competition as keen as it is at present, it is not possible to enforce interest payments on overdue accounts, as is done in some lines, but the day when this can be done is looked forward to by the trade.

Regulation of scrap prices by the government at present is bringing the scrap industry closer together than ever before and high hopes are entertained that a strong organization may result, which will be able to bring about reforms much needed.

One modern banking device is being looked on with favor by larger scrap dealers as a solution of some of the present difficulties of financing. This is the trade acceptance. The benefit of the adoption of the trade acceptance has been pointed out generally and it is particularly advantageous to the scrap dealer. The day of its general use in this trade seems not far off because of its unusually attractive features. Once adopted it seems probable it will become permanent.

Applied to the scrap business it will result in the elimination of the sight draft and spot cash terms of payment. Both of these methods of payment have been unsatisfactory as they require much time and expense. It also will eliminate tying up funds much needed for other purposes.

It will do away largely with delayed payments, which have had much to do with restricting and curbing business activities. When a buyer knows that his obligation must be met at a certain time he will prepare to take care of it and will avoid speculation and unnecessary hazards. This result will strengthen the business materially.

Adoption of the trade acceptance is being considered by many of the larger dealers and it now is in effect to some extent in the business of several, who have found it works out satisfactorily and smoothly. Concerted action on the part of large scrap dealers would assist materially in its general use, to the great gain of the industry, as well as business in general.

APPENDIX A

Railway Storekeepers' Classification

The steady progress toward giving shape and substance to the iron and steel-scrap trade by means of workable specifications dates from the adoption of the list of descriptions of scrap grades by the Railway Storekeepers' association. The storekeepers' specifications are so clear and plain that all may understand them, and they really form the backbone of all other classifications. The details of these railway specifications are given herewith.

1 **ARCH BARS AND TRANSOMS, IRON.**

2 **ARCH BARS AND TRANSOMS, STEEL.**

3 **AXLES, IRON.** Driving and other axles, 6 inches diameter and over.

4 **AXLES, STEEL.** Driving and other axles, 6 inches diameter and over.

5 **AXLES, IRON.** Car, tender, engine truck and other axles, car and locomotives, under 6 inches diameter.

6 **AXLES, STEEL.** Car, tender, engine truck and other axles, car and locomotive, under 6 inches diameter.

7 **ANGLE BARS, SPLICES AND FISH PLATES IRON.** For patented joints see No. 36.

8 **ANGLE BARS, SPLICES AND FISH PLATES STEEL.** For patented joints see No. 36.

9 **BRAKE BEAMS, UNCUT.** All metal brake beams.

10 **BOLSTERS, UNCUT,** (except cast steel). To include all metal built up type body and truck bolsters.

11 **BOILERS, UNCUT.** Locomotive and stationary boilers, locomotive tanks, other heavy oil tanks, fire boxes without flues or trimmings, but including mud rings.

12 **BOILERS, CUT UP.** Locomotive and stationary boilers, locomotive tanks, other heavy oil tanks, fire boxes without flues or trimmings, but including mud rings, cut in sheets and rings.

13 **BUSHELING. No. 1.** Iron and soft steel pipes and flues (free from scales); tank and bands No. 12 and heavier, boiler plate punchings and clippings, and soft steel and iron drop forgings, and trimmings; nothing to be over 8 inches long or wide, free from galvanized or tinned stock.

14 **BUSHELING, No. 2.** Cut hoops, sheet cotton ties and similar light material; nothing to be over 8 inches long or wide; bundled wire and bundled sheet suitable for busheling without further preparation; bundles not to weigh over 40 pounds and not to be over 15 inches in height, width or length; all free from hard steel, cast and malleable and galvanized or tinned stock.

15 **CAST, No. 1 RAILROAD.** Pieces weighing 150 pounds or less, includes new grates, new stove plate, clean cast iron culvert, soil and water pipe; free from burnt grates, burnt stove plate and brake shoes.

16 **CAST, No. 1A RAILROAD.** Cylinders and wheel centers.

17 **CAST, No. 2 RAILROAD.** Pieces weighing over 150 pounds; can include new grates and new stove plate; free from burnt grates, burnt stove plate; also exclusive of cylinders and wheel centers.

18 **CAST, No. 3 RAILROAD.** All kinds of burnt castings, including grate bars, grate frames, stove plate, hand car and truck wheels with wrought iron spokes.

19 **CAST IRON BORINGS.** Clean and free from other metals, dirt and lumps.

20 **CHAIN, IRON.** All sizes, regardless of length. (May be included in No. 1 railroad wrought.)

21 **CHAIN STEEL.** All sizes, regardless of length.

22 **CHANNELS, IRON.** Car truck, cut apart.

23 **CHANNELS, IRON.** Car truck, uncut.

24 **CHANNELS, STEEL.** Car truck, cut apart.

25 **CHANNELS, STEEL.** Car truck, uncut.

26 **STEEL COUPLERS AND KNUCKLES.** Cast steel couplers, knuckles and coupler heads.

27 **FROGS AND SWITCH POINTS, UNCUT.** 50 pound section and over.

28 **DRILLINGS AND OILY CHIPS.** Wrought iron and soft steel.

29 **FLUES AND PIPES.** Flues and pipes, boiler flues, wrought iron and steel pipe, regardless of lengths without removing scrap fittings, such as couplings, elbows, tees, etc.

30 **LIMED IRON AND STEEL.** All kinds (except flues) from the interior of boilers, which are incrusted with lime or corroded by the action of water, such as crown bars, crown bar bolts, staybolts, etc.

31 ***STRUCTURAL AND SHAPED IRON, No. 1, CUT UP** Channels (except car truck channels, see item 22), angles, tees, "I" beams, girders and columns, except cast. (See foot note.)

32 ***STRUCTURAL AND SHAPED IRON, No. 2, UNCUT.** Channels (except car truck channels, see item 23), angles, tees, "I" beams, girders and columns, except cast. (See foot note.)

33 ***STRUCTURAL AND SHAPED STEEL, No. 1, CUT UP.** Channels (except car truck channels, see item 24), angles, tees, "I" beams, girders and columns, except cast. (See foot note.)

34 ***STRUCTURAL AND SHAPED STEEL, No. 2, UNCUT.** Channels (except car truck channels, see item 25), angles, tees, "I" beams, girders and columns, except cast. (See foot note.)

35 ***STRUCTURAL AND SHAPED IRON AND STEEL MIXED, UNCUT.** Channels (except car truck), angles, tees, "I" beams, girders and columns, except cast. (See foot note.)

36 RAIL JOINTS. All patented joints.

37 MALLEABLE. All malleable castings.

38 IRON RAIL, No. 1. 5 feet and over, 50 pounds and over standard T section, free from frog, switch and guard rails and bent and crooked rails.

39 IRON RAIL, No. 2. Cropped rail ends, 3 feet and under.

40 IRON RAIL, No. 3. 3 feet long and over 50 pounds and over standard T section; also bent and crooked rails.

41 IRON RAILS, No. 4. Frog, switch and guard rails.

42 STEEL RAIL, No. 1. 5 feet long and over 50 pounds and over standard section, free from frog, switch, guard, bent, curved and circle rails.

43 STEEL RAIL, No. 2. Cropped rail ends under 3 feet long; 50 pound section and over.

44 STEEL RAIL, No. 3. 3 feet long and over, 50 pounds and over, split heads and worn flanges, curved and bent rails, free from frog, switch and guard rails.

45 STEEL RAIL, No. 4. All sections of rail not coming under specifications of No. 1, 2 or 3 rail, including frogs, cut apart, guard rails and switch points. Does not include frog fillers or plates.

46 LIGHT SHEET, No. 1. Under ¼ inch, consisting of cut smoke stacks, netting, wire rope (not galvanized), hoops, band iron and steel, pressed steel hand car wheels, scoops, shovels, iron wire, free from galvanized iron and tin. Exclusive of material coming under classification of "Busheling".

47 LIGHT SHEET, No. 2. Galvanized iron and tin, galvanized rope, roofing, tinware, etc.

48 HEAVY SHEET. ¼ inch and over, including tank, boiler and fire box steel and iron, cut up, bridge plates, frog and crossing plates. Exclusive of material coming under classification of "Busheling".

49 BRAKE SHOES, No. 1. Plain gray iron.

50 BRAKE SHOES, No. 2. Miscellaneous including all shoes with steel back or with steel or wrought iron insert, both driving and car.

51 SPRING STEEL, No. 1. Flat; includes all pieces of flat spring steel, old or broken leaf or elliptic springs, from which the bands and bolts have been removed.

52 SPRING STEEL, No. 2. All coil springs made from steel 3-1 inch and over in any diameter.

53 SPRING STEEL, No. 3. Coil springs made from steel under 3-1 inch, any diameter.

54 CAST STEEL, No. 1. Charging box, size 5 feet and under, under 18 inches wide; no piece weighing less than 10 pounds to be included.

55 CAST STEEL, No. 2. Over 5 feet long and 18 inches wide.

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56 HEAVY MELTING STEEL, No. 1. "No. 1 heavy melting steel or wrought iron, charging box size not over 5 feet long nor 18 inches wide. Includes cropped ends from bars, blooms or rails, also angles, channels, I beams, plates, track angle bars and rail joints. Exclusive of curly or unwieldy pieces.

No piece to be more than 5 feet long nor more than 18 inches wide nor less than ¼ inch thick. No piece to weigh less than 10 pounds.

57 HEAVY MELTING STEEL, No. 2. Over 5 feet long and 18 inches wide; including all steel scrap not otherwise specified.

58 TOOLS AND TOOL STEEL. Files and worn out steel tools, including old claw bars, pinch bars, spike mauls, track wrenches, picks, adzes, axes, chisels, drills, hammers, knuckle pins, punches, tool steel, finger pins, bits, draft keys, bar steel, weighing under 10 pounds per piece.

59 TIRES, No. 1. All locomotive driving engine truck and coach tires in 36 inches and over inside diameter, smooth inside, not grooved for retaining rings.

60 TIRES, No. 2. All tires not included in No. 1.

61 TURNINGS AND DRILLINGS, No. 1. Wrought iron and soft steel, clean and fine from cast borings, brass, hard steel, other metals, dirt and lumps.

62 TURNINGS AND DRILLINGS, No. 2. From tires and other similar steel, including hard steel; clean, free from other metals, dirt and lumps.

63 TURNINGS, DRILLINGS AND BORINGS. No. 1. Wrought, cast and steel mixed; free from other metals, dirt and lumps.

64 TURNINGS, DRILLINGS AND BORINGS, No. 2. Wrought, cast and steel mixed with brass and other metals; free from dirt and lumps.

65 WROUGHT, No. 1 EXTRA RAILROAD. Rods and bars 1⅛ inches in diameter and larger; 6 feet and over.

66 WROUGHT, No. 1 RAILROAD. Clean wrought iron from railroad equipment, pieces measuring 4 inches long and over (exclusive of threads) may include rods and bolts ⅝ inch in diameter and over (except track bolts) also drawbar yokes, bridge iron in bars or rods, switch rods, heavy iron chain, links and pins; free from riveted material.

67 WROUGHT, No. 2 RAILROAD. All wrought iron under 6 inches long not specified under No. 1; to include track spikes, bolts and nuts, rivets and lag screws.

APPENDIX B

American Foundrymen's Association Classification

The classification of the American Foundrymen's association is spreading gradually in use among foundries throughout the country and appears destined to exert even wider influence in the effort to standardize the various grades of scrap. These specifications are as follows:

CAST IRON SCRAP

No. 1 Machinery Scrap

This material shall consist of cast iron scrap of first quality which possesses evidence of having been machined, such as planed or turned surfaces, bored or drilled holes, etc. It must be cupola size, no piece to weigh more than 100 pounds, and must not exceed 24 inches in length or width. It shall be classified as follows:

No. 1 Heavy, pieces greater than 1 inch in section.

No. 1 Medium, pieces ½ inch and not to exceed 1 inch in section.

No. 1 Light, pieces not to exceed ½ inch in section.

Scrap classified as railroad cast scrap or under any other classification of these specifications, and burned iron of every description will not be accepted under the foregoing classifications.

No. 2 Machinery Scrap

This material shall consist of cast iron scrap of first quality which possesses evidences of having been machined, such as planed or turned surfaces, bored or drilled holes, etc. It shall be in the unbroken state. It shall be classified as follows:

No. 2 Heavy, pieces greater than 1 inch in section.

No. 2 Medium, pieces over ½ inch in section and not to exceed 1 inch.

No. 2 Light, pieces not to exceed ½ inch in section.

Scrap classified as railroad cast scrap or under any other classification of these specifications, and burned iron of every description will not be accepted under the foregoing classifications.

No. 3 Rough Scrap

This material shall consist of cast scrap such as columns, pipe, plates and rough castings of a miscellaneous nature broken to cupola size, pieces not to exceed 100 pounds in weight and must not exceed 24 inches in length or width. It shall be classified as follows:

No. 3 Heavy, pieces greater than 1 inch in section.

No. 3 Medium, pieces over ½ inch and not to exceed 1 inch in section.

No. 3 Light, pieces not to exceed ½ inch in section.

Scrap classified as railroad cast scrap or under any other classification of these specifications, and burned iron of every description will not be accepted under the foregoing classifications.

No. 4 Rough Scrap

This material shall consist of cast scrap such as columns, pipes, plates and rough castings of a miscellaneous nature in the unbroken state. It shall be classified as follows:

No. 4 Heavy, pieces greater than 1 inch in section.

No. 4 Medium, pieces over ½ inch and not to exceed 1 inch in section.

No. 4 Light, pieces not to exceed ½ inch in section.

Scrap classified as railroad scrap or under any other classification of these specifications, and burned iron of every description will not be accepted under foregoing classifications.

No. 5 Machinery Scrap

This material shall consist of burned machinery scrap of miscellaneous character, but must not include any burned material included in any other classification of these specifications.

No. 1 Stove Plate Scrap

This material shall consist of the best class of clean stove plate. It must be free from malleable iron and steel parts, grates, burnt iron and other miscellaneous scrap usually collected with this material.

Scrap classified as railroad scrap or under any other classification of these specifications, and burned iron of every description will not be accepted under this classification.

No. 2 Stove Plate Scrap

This classification includes all unburned cast iron stove parts not included in the No. 1 stove plate classification.

Scrap classified as railroad scrap or under any other classification of these specifications, and burned iron of every description will not be accepted under this classification.

No. 3 Stove Plate Scrap

This material shall consist of burned stove parts of every description, but must not include any burned material included in any other classification of these specifications.

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No. 1 Agricultural Scrap

This material shall consist of cast iron parts of agricultural machinery and shall be free from steel, malleable, chilled iron, such as plow points, etc., and burned iron of every description.

No. 2 Agricultural Scrap

This material shall consist of chilled iron parts of agricultural machinery and must be free from steel, malleable and burned iron of every description.

No. 1 Railroad Scrap

This material shall consist only of chilled cast iron car wheels conforming to the Master Car Builders' association standards.

No. 2 Railroad Scrap

This material shall consist of miscellaneous cast iron car wheels not included in the No. 1 classification.

No. 3 Railroad Scrap

This material shall include only plain gray iron brake shoes, which must be free from steel backs and inserts.

No. 4 Railroad Scrap

This material shall include steel back and insert brake shoes of both driver and car types. It shall not include brake shoes of the No. 3 classification.

No. 5 Railroad Scrap

This material shall consist of railroad burned iron of every description.

No. 6 Railroad Scrap

This classification includes unburned railroad grate bars and grate bar rests, and journal boxes with steel parts removed.

No. 1 Radiator Scrap

This material shall consist of radiator castings, broken, with all steel malleable and other parts removed. It must be free from scale and excessive rust or corrosion.

No. 2 Radiator Scrap

This material shall consist of radiator castings, not broken, with all steel, malleable and other parts removed. It must be free from scale and excessive rust or corrosion.

SCRAP METALS

MALLEABLE CAST SCRAP

Only such scrap as has undergone the annealing process will be acceptable under the following classifications:

Automobile Malleable Scrap

This material shall consist of malleable cast iron parts of automobiles and must be free from steel forgings, stampings and gray iron parts. Railroad malleable, agricultural malleable and miscellaneous malleable, such as valves, flanges and pipe fittings, will not be accepted under this classification.

Railroad Malleable Scrap

This material shall consist of malleable iron parts of railway cars and other equipment. It shall be classified as follows:

No. 1 Railroad Malleable, pieces not exceeding ⅜ inch in section; also not exceeding 24 inches in length or width.

No. 2 Railroad Malleable, pieces not less than ⅜ inch and not greater than ¾ inch in section; also not exceeding 24 inches in length or width.

No. 3 Railroad Malleable, pieces greater than ¾ inch in section and exceeding 24 inches in length or width.

Agricultural malleable and miscellaneous malleable, such as valves, flanges and pipe fittings will not be accepted in this classification.

Agricultural Malleable Scrap

This material shall consist of malleable cast iron parts of agricultural machinery. It must be free from steel and cast iron. It shall be classified as follows:

No. 1 Agricultural Malleable, pieces not exceeding ⅜ inch in section; also not exceeding 24 inches in length or width.

No. 2 Agricultural Malleable, pieces not less than ⅜ inch in section and not exceeding ¾ inch; also not exceeding 24 inches in length or width.

No. 3 Agricultural Malleable, pieces greater than ¾ inch in section and exceeding 24 inches in length or width. Miscellaneous malleable such as valves, flanges and pipe fittings will not be accepted under this classification.

Miscellaneous Malleable Scrap

This material shall consist of valves, flanges and pipe fittings of every description and such malleable cast iron scrap as fails to conform to other classifications.

APPENDIX B

OPEN-HEARTH STEEL SCRAP

Heavy Open-Hearth Scrap

No. 1 Heavy Structural Steel Scrap.—This material shall consist of all structural shapes, such as channels, angles, I-beams, plates, etc., ¼ inch in section and heavier. It must be of charging box size, not to exceed 5 feet long and 18 inches wide. No piece shall weigh less than 25 pounds. It must be free from iron of every description. This material must not include pieces that are covered with excessive rust or corrosion.

No. 2 Heavy Structural Steel Scrap.—This material shall consist of all structural shapes ¼ inch in section and heavier, over 5 feet long and 18 inches wide. No piece shall exceed 600 pounds in weight. This material must be free from bent, curved and twisted pieces, and iron of every description. It must not include any material that is covered with excessive rust or corrosion.

No. 3 Steel Rails.—This material shall consist of standard sections, 50 pounds and over, free from frogs, switches, guard rails and crossing rails. It must be of charging box size not over 5 feet long and 18 inches wide. It must not include any pieces that are covered with excessive rust or corrosion.

No. 4 Steel Rails.—This material shall consist of standard sections under 50 pounds and free from frogs, switches, guard rails and crossing rails. It must be of charging box size not over 5 feet long and 18 inches wide. It must not include any pieces that are covered with excessive rust or corrosion.

No. 5 Steel Rails.—This material shall consist of standard sections, 50 pounds and over, not cut to charging box size. It must be free from frogs, switches, guard rails and crossing rails, and must not include any pieces that are covered with excessive rust or corrosion.

No. 6 Steel Rails.—This material shall consist of standard sections under 50 pounds, not cut to charging box size. It must be free from frogs, switches, guard rails and crossing rails, and must not include any pieces that are covered with excessive rust or corrosion.

No. 7 Heavy Steel Scrap.—This material shall consist of guard rails, switches, crossing rails, frogs, exclusive of iron plates, etc. It must be cut apart and be of charging box size, not to exceed 5 feet long and 18 inches wide, and must not include any pieces that are covered with excessive rust or corrosion.

No. 8 Heavy Steel Scrap.—This material shall consist of frogs, guard rails, switches and crossing rails, not cut apart, over 5 feet long and 18 inches wide. It must be free from bent, curved and twisted pieces, and must not include any pieces that are covered with excessive rust or corrosion.

No. 9 Heavy Steel Scrap.—This material shall consist of locomotive drivers, engine truck and coach tires, 36 inches and over inside diameter, and must be free from excessive rust or corrosion.

No. 10 Heavy Steel Scrap.—This material shall consist of miscellaneous steel tires under 36 inches in diameter, and must be free from excessive rust or corrosion.

No. 11 Steel Tires.—This material shall consist of steel tires as covered by classifications Nos. 9 and 10. It must be broken to charging box size, not over 5 feet long and 18 inches wide.

No. 12 Heavy Steel Scrap.—This material shall consist of mild steel castings of a miscellaneous character. No piece shall weigh more than 300 pounds or less than 25 pounds. It must not contain malleable or cast iron and must be free from excessive rust or corrosion. It must not exceed charging box size, 5 feet long and 18 inches wide.

No. 13 Heavy Steel Scrap.—This material shall consist of cast steel couplers, coupler heads, knuckles and draw bars. It must be free from iron yokes, etc., and must be free from excessive rust or corrosion.

LIGHT OPEN-HEARTH SCRAP

No. 1 Light Steel Scrap.—This material shall consist of steel springs, including all standard railroad coil and elliptical springs. No bar or coil springs under ⅜ inch in thickness or diameter will be accepted. The spring shall be free from plates. Elliptical springs must be cut apart. The material must be free from excessive rust or corrosion.

No. 2 Light Steel Scrap.—This material shall consist of miscellaneous steel, such as plates, shapes, bars, structural crop ends, forging crop ends, fish plates, steel rail chairs, rail joints, etc. It must be limited to charging box size, not over 5 feet long and under 18 inches wide. It also must be under 25 pounds of weight, and must not include bundle scrap or iron of any description. It must be free from excessive rust and corrosion.

No. 3 Light Steel Scrap.—This material shall consist of turnings, drillings and borings from wrought iron and mild steel. They must be clean and free from cast iron and malleable borings, brass, high-carbon steel borings and other metals. The material also must be clean and free from dirt and lumps, as well as from excessive rust or corrosion.

No. 4 Light Steel Scrap.—This material shall consist of turnings, drillings and borings from high-carbon steel, such as tires and other similar material. This material must be clean and free from cast iron and malleable borings, brass and other metals. It also must be clean and free from dirt and lumps. It must be free from excessive rust or corrosion.

No. 5 Light Steel Scrap.—This material shall consist of bundled scrap and all light steel scrap under ¼ inch in section, free from tinned and galvanized material. It must not be larger than charging box

size, that is 5 feet long and under 18 inches wide. It also must be clean and free from excessive rust or corrosion.

No. 6 Light Steel Scrap.—This material shall consist of miscellaneous cast steel not covered by other classifications. No piece shall weigh more than 25 or less than 5 pounds. It must be free from malleable, cast iron, etc., as well as be clean and free from excessive rust or corrosion.

CONVERTER STEEL SCRAP

No. 1 Converter Scrap.—This material shall consist of mild open-hearth steel scrap, such as structural shapes, rolling mill crop ends, forgings and forge crop ends. No piece shall weigh more than 200 pounds or less than 25 pounds, and must not exceed 24 inches in length or width. The material must be free from excessive rust or corrosion.

No. 2 Converter Scrap.—This material shall consist of open-hearth steel scrap, such as rails and high carbon, or hard steel scrap of a miscellaneous character. No piece shall weigh less than 25 pounds or more than 200 pounds, or be greater than 24 inches in length or width. The material must be free from excessive rust or corrosion.

No. 3 Converter Scrap.—This material shall consist of miscellaneous mild steel castings. No piece shall weigh more than 200 pounds or less than 25 pounds. The material must not contain malleable or cast iron, must not exceed 24 inches in length or width, and must be free from excessive rust or corrosion.

No. 4 Converter Scrap.—This material shall consist of miscellaneous mild steel castings. No piece shall weigh more than 25 pounds. The material must not contain malleable or cast iron, must not exceed 24 inches in length or width, and must be free from excessive rust or corrosion.

No. 5 Converter Scrap.—This material shall consist of miscellaneous steel tires, broken. No piece shall exceed 24 inches in length or width. The material must be free from excessive rust or corrosion.

No. 6 Converter Scrap.—This material shall consist of mild open-hearth steel scrap, such as punchings, shearings, forge flashings, forge crop ends, etc. No piece shall weigh more than 25 pounds or less than 5 pounds. The material must be clean and free from excessive rust or corrosion.

No. 7 Converter Scrap.—This material shall consist of steel springs, including all railroad coil and elliptical springs, but no coil or bar springs shall be under $\frac{3}{8}$ inch in thickness or diameter. They must be free from plates. Elliptical springs must be cut apart and must not exceed 24 inches in length, and the material must be free from excessive rust or corrosion.

CRUCIBLE STEEL SCRAP

No. 1 Crucible Scrap.—This material shall consist of open-hearth steel punchings and must be free from shearings, clippings, tinned and

galvanized material of every description. It must be clean and free from dirt and excessive rust or corrosion.

No. 2 Crucible Scrap.—This material shall consist of mild open-hearth steel shearings, forgings, forge flashings and clippings. No piece shall exceed 5 inches wide or 8 inches long. It must be free from dirt, tinned and galvanized material of every description and free from excessive rust or corrosion.

No. 3 Crucible Scrap.—This material shall consist of carbon tool steel, such as files, stub ends of carbon tools, carbon steel saw blades, wearing plates, etc. No piece shall exceed 5 inches wide or 8 inches long, and the material must be free from excessive rust and corrosion.

No. 4 Crucible Scrap.—This material shall consist of steel springs of miscellaneous character, not exceeding 5 inches diameter or width and 8 inches long. It must be free from plates and other metals and free from excessive rust or corrosion.

No. 5 Crucible Scrap.—This material shall consist of steel horse shoes, horse shoe nails, steel buckles, steel snaps, steel clamps, etc., and must be free from rubber, leather or other substances. It must be clean and free from excessive rust or corrosion.

No. 6 Crucible Scrap.—This material shall consist of miscellaneous small soft steel castings, not exceeding 10 pounds in weight or 5 inches wide and 8 inches long. It must be free from malleable, cast iron or other metals, and also must be free from excessive rust or corrosion.

ELECTRIC FURNACE STEEL SCRAP

No. 1 Electric Furnace Scrap.—This material shall consist of mild open-hearth steel punchings, but must not include shearings, clippings or other materials. It must be free from tinned and galvanized material of every description, and must also be clean and free from dirt and excessive rust or corrosion.

No. 2 Electric Furnace Scrap.—This material shall consist of mild open-hearth steel, such as plates, shapes, structural crop ends, shearings and miscellaneous materials of this character. It must be not less than ¼ inch in section. No piece shall exceed 12 inches wide and 24 inches long, or weigh less than 10 pounds or more than 200 pounds. The material must be free from excessive rust or corrosion. Bundle scrap and iron of every description will not be accepted.

No. 3 Electric Furnace Scrap.—This material shall consist of mild open-hearth steel, such as rolling mill crop ends, forge crop ends, and forgings. No piece shall weigh less than 10 pounds or more than 200 pounds. The material must be free from excessive rust or corrosion.

No. 4 Electric Furnace Scrap.—This material shall consist of miscellaneous steel tires, broken. No piece shall exceed 12 inches wide or 24 inches long, and the material must be free from excessive rust or corrosion.

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No. 5 Electric Furnace Scrap.—This material shall consist of high carbon open-hearth steel, such as rails, and high carbon or hard steel of miscellaneous character. No piece shall weigh less than 25 pounds or more than 200 pounds or exceed 12 inches wide or 24 inches long. This material must be free from excessive rust or corrosion.

No. 6 Electric Furnace Scrap.—This material shall consist of mild open-hearth steel, such as plates, shapes, structural crop ends, shearings and clippings, under ¼ inch in section. No piece shall exceed 12 inches wide and 24 inches long. Bundle scrap will be excluded, and the material must be free from hoops, cotton ties, wire, etc., commonly known as busheling, together with tinned and galvanized material of every description. It also must be free from excessive rust or corrosion.

No. 7 Electric Furnace Scrap.—This material shall consist of carbon tool steel of miscellaneous character, such as files, stub ends of tools, carbon tool steel rollers, wearing plates, etc. No piece shall exceed 12 inches wide or 24 inches long. This material must be free from other metals and excessive rust or corrosion.

No. 8 Electric Furnace Scrap.—This material shall consist of steel springs, including all standard railroad coil and elliptical springs. No bar or coil springs shall be under ⅜ inch in thickness or diameter. The springs shall be free from plates and other materials. Elliptical springs must be cut apart and not exceed 24 inches in length. This material must be free from excessive rust or corrosion.

No. 9 Electric Furnace Scrap.—This material shall consist of coil and leaf or elliptical springs under ⅜ inch in thickness or diameter. The springs shall be free from plates and other material. Leaf or elliptical springs must be cut apart and not exceed 24 inches in length. This material must be free from excessive rust or corrosion.

No. 10 Electric Furnace Scrap.—This material shall consist of heavy trimmings from high carbon or hard steel. Open-hearth steel must be free from light and curly turnings. It must be clean and free from excessive rust and corrosion.

No. 11 Electric Furnace Scrap.—This material shall consist of heavy turnings from mild or soft open-hearth steel, free from light and curly turnings. It must be free from excessive rust or corrosion.

Note.—Material coming under all of the foregoing classifications for electric furnace steel scrap, when purchased for the acid process is limited to 0.04 per cent phosphorus and sulphur.

WEIGHTS

Net Tons

All scrap bought or sold under these specifications shall be handled only on a net ton basis, said ton to consist of 0200 pounds.

Variations

Variations in weights shall be subject to the regulations of the authorized weighing association operating in the territory to which the material is delivered.

REJECTIONS

The purchaser reserves the right to reject any material failing to conform to these specifications.

In the event of a rejection, all demurrage charges and return freight shall be paid by the seller.

APPENDIX C

Mill Specifications

Allegheny Steel Co., Breckenridge, Pa.

Clean Cast Iron Borings:—Free from dirt and other foreign substances.

Clean Steel Machine Shop Turnings.—Free from dirt and other foreign substances.

Heavy Cast Iron Machinery Scrap.—Free from burnt material, anvil blocks and other material too heavy to be readily broken under drop.

American Steel & Wire Co., Worcester, Mass.

Heavy melting steel and wrought iron scrap—Railroad angle bars, fish plates, splices, knuckles and couplers, steel castings, heavy crops over 6 inches in length, and other heavy steel scrap, not over 60 inches long and 18 inches wide. Must be free from cast malleable and burned iron, punchings and skeleton scrap, shoveling scrap and pipe. Wagon springs or leaf springs must be cut apart, buggy tires must be sheared to 10-inch lengths and attachments removed, and scrap must be reasonably straight and of a heavy nature.

Shear stock—To consist of T-rails, girder rails, free from cast iron, shafting under 3-inch diameter, I-beams not over 4 inches across the top, angle iron, Z-bars, channels, buggy and wagon axles free from attachments. Plates and other shear stock must not be over 4 inches wide. Frogs and crossings must be cut apart. Any length will be accepted if not badly twisted or bent. Must be loaded separate from scrap prepared for charging.

American Steel Foundries, Chicago, Ill.

For plants at Pittsburgh and Franklin, Pa., and Indiana Harbor, Ind., the specification is as follows:

Low phosphorus billet and bloom crop ends and heavy straight plate scrap. In charging box size, guaranteed 0.04 per cent and under in sulphur and phosphorus. Pieces must not weigh less than 15 pounds nor more than 300 pounds and must be under 3¾ feet long and 18 inches wide.

The plant at Chester, Pa., requires sulphur and phosphorus at or under 0.035 per cent. For this company's plants at Granite City and East St. Louis, Ill., Alliance, O., and Sharon, Pa., the specification is as follows:

Steel rails and heavy railroad steel—frogs, guards and switches must be cut apart and consist of rails under 45 pounds a yard. Leaf

springs must be whole. Reinforced switch points must be sheared to charging box size, not over 4 feet long and 18 inches wide. Rails with chairs, crooked or curved rails, steel bolsters, whole locomotive tires, and boiler plate are not accepted. Pieces must not weigh less than 15 pounds. Shipments must not contain more than half rails, of which one third may be straight girder rails, but free from cast welds and cement. For shipment to the Sharon plant no piece may be over 3½ feet long, except rails.

Andrews Steel Co., Newport, Ky.

No. 1 Country Steel Scrap.—All steel parts of agricultural implements, wagons and buggies, clippings ⅛ inch thick and heavier, free from malleable and all charging box size.

No. 1 Railroad Heavy Melting Steel.—Charging box sizes, except T-rails, which may be random lengths, frog, switch and guard rails to be cut apart.

Mixed Steel, Malleable and Breakage Scrap.—Country scrap free from sheet iron, old wire, stoves or stove parts, boilers or parts, unless in heavy charging box sizes, free from heavy material over 6 feet long and 4 inches in diameter. Not over 25 per cent of breakage which must be sheared to charging box size.

Cast Iron Borings.—Clean and free from dirt, lumpy or rusty borings, foreign material or brass.

Iron and Steel Turnings.—Heavy turnings easily shoveled, free from light, stringy turnings which must be forked, free from cast iron borings or foreign material, rusty turnings, brass or oil. Drillings not accepted.

New Black Bundled Sheet Scrap.—New black sheet steel shearings from sheet or tin plate mill, wire-bundled to charging box size, black sheet shearings from electric or stamping works compressed into bundles not exceeding 24 inches square, free from rusty, tinned or galvanized material. No loose material in cars.

Cut Pipe and Tank Scrap.—Sheared tank scrap ⅛ inch and heavier, 12 to 16 inches wide and under 30 inches long, clean and free from scale and lime. Pipe 6 inches and under in diameter in straight pieces 5 feet and under, all steel or iron, free from scale and lime, no tinned or galvanized material of foreign substances.

Light Steel Scrap.—Charging-box size, consisting of cut wagon and buggy tires and other steel scrap, but no sheets, malleable, bicycle spokes or similar scrap to be included.

No. 2 Busheling Scrap.—Cut hoops, sheets, cotton ties and similar light material, nothing over 8 inches long or wide, bundled wire and bundled sheets needing no preparation for busheling, tightly bundled so as not to come loose in transit, charging-box size, free from galvanized or tinned stock.

Bundled Hay Wire.—Bundled to charging-box size so as not to come loose in transit or handling, black iron or steel wire, free from copper, zinc or tinned coating or other foreign material or rusty stock.

APPENDIX C

No. 1 Heavy Melting Steel Scrap.—Steel axles, boiler plates ¼ inch thick or heavier, free from lime or scale, steel I-beams, channels and angles, charging-box size, or such as can be lifted by one man, excluding light steel malleable or other objectionable material.

No. 1 Shoveling Steel Scrap.—Nuts, bolts, spikes, bar ends, crop ends and heavy punchings and clippings, no piece less than 1½ inches long, or ½ to ¾ inch in diameter or equivalent.

No. 1 Agricultural and Heavy Busheling Scrap.—Must consist of 50 per cent spikes, bolts, nuts and horseshoes and 50 per cent heavy agricultural steel scrap, plows, wagon springs and similar scrap, free from forks, shovels and malleable, all charging-box size.

Axle Turnings.—Heavy iron and steel turnings from railroad axles in clean, merchantable condition, free from dirt or foreign material.

Atlantic Steel Co., Atlanta, Ga.

Heavy Melting Steel.—Not over 5 feet, 6 inches long and 24 inches wide, including forged, cast or rolled steel, no piece less than 3 pounds.

No. 1 Melting Steel.—Rods, pins, bolts and bars of all kinds, rail crop ends, steel forgings, steel rails, crank pins, piston rods, links, link hangers, connecting rods, springs, steel angle bars, tie plates, tool steel, pressed steel rail braces, switch slides, boiler plate clippings and shearings ⅜-inch thick or over, not more than 2 feet wide or 3 feet long, steel wagon and buggy tires, ⅜-inch or heavier, steel plows, horseshoes, circular saws not over 24 inches in diameter, brake beams, channels, I-beams and other structurals, cut apart, steel castings not over 5 feet, 6 inches long, 2 feet wide and 1 foot, 6 inches thick. Bolted, riveted or otherwise fabricated material free from cast iron will be accepted. Must contain 60 to 75 per cent heavy material. Fine material must be loaded at one end of car.

Sets Weight Minimum

Steel Rails.—Rails 6 feet and over, free from frogs, switches and wings, and girder rails, 40 pounds and heavier.

The Gulf States Steel Co., Birmingham, Ala., has some general requirements applying to all grades. It requires full carloads, long straight lengths, under 4 inches and over 2 inches in diameter, all lengths straight rails, 40-pound sections and over, frogs, switches and guards cut apart, straight bars and axles 4 to 2 inches in diameter.

All fine material must be loaded at the bottom or one end of the car, only open gondola cars to be used. If fine material is loaded on top it will be cause for rejection. Turnings, malleable or cast scrap, car wheels, locomotive tires over 30 inches, corrugated or other sheets lighter than 20-gage are not accepted. Material not coming within following classifications, consisting of heavy melting steel, such as channels, I-beams and structural or light material, planer chips and steel borings and punchings will be bid on when complete description is given.

Company also buys busheling, cast iron borings and turnings of clean stock on same specifications as other mills.

No. 1 Heavy Steel Scrap.—No piece over 6 feet long, 2 feet wide or 1 foot, 6 inches thick, steel bolts, pins, rods, bars, piston rods, rail crops, connecting rods, crank pins, springs, horseshoes, tie plates, switch slides, plate clippings over $\frac{3}{16}$-inch thick, I-beams, channels and structural steel. Fabricated material within the above size will be accepted free of cast iron. Pipes and flues not accepted.

No. 2 Mixed Steel Scrap, Short Lengths.—Not over 6 feet long, 2 feet wide or 1 foot, 6 inches thick. Not more than 10 per cent light material, sheet clippings, conveyor chains, wrought or steel pipe or bundle wire.

No. 3 Mixed Steel Scrap, Long Lengths.—Not more than 10 per cent in any car of light material or 10 per cent of riveted car bolsters or other fabricated material exceeding 6 feet long.

Bethlehem Steel Co., South Bethlehem, Pa.

No. 1 Steel Scrap.—Strictly heavy melting steel scrap in charging box shape, except T-rails, which will be accepted in long lengths if loaded separately. Guaranteed to be satisfactory in quality and shape and subject to inspection and acceptance.

No. 1 Clean Cast Iron Borings.—Free from rust, turnings or other material.

Clean Cast Iron Borings.—These borings may contain steel or wrought iron turnings but the greater percentage must be cast iron borings. Turnings must be strictly short chips free from light turnings, stringy or tangled stock.

Low Phosphorus.—Boiler plate punchings, $\frac{1}{4}$-inch thick or over, not less than $\frac{3}{4}$-inch nor more than 3 inches in diameter, guaranteed not over 0.035 phosphorus and sulphur, free from other material and suitable for crucible use.

Brier Hill Steel Co., Youngstown, O.

No. 1 Heavy Melting Steel.—Railroad steel and heavy steel croppings from rails, billets, blooms, plates, structural shapes, rods, channels, bars, steel plate shearings, angles, steel rolls and other similar material. Needle and skeleton scrap is not acceptable. All must be charging box size, not over 6 feet long and 18 inches wide, not less than $\frac{1}{4}$-inch thick, not less than 10 pounds or over 300 pounds per piece. No agricultural shapes, boiler tubes, old pipe, grate bars, brake shoes, cast iron, sheet stock, or light stock, curly or unwieldy pieces will be accepted. Material must be clean and free from all dirt and rubbish and excessive rust. Must be loaded in cars containing no other grades.

Shoveling Steel.—Heavy, clean stock, railroad track scrap, spikes, nuts, bolts, boiler and bridge punchings and clippings, small crop ends, bolt ends and similar material. Must be over $\frac{1}{4}$-inch in thickness, not

over 12 inches in length or width. No light or tangled material or skeleton scrap will be accepted. Must be loaded in cars containing no other grades.

Bundled Sheet Scrap.—Strictly new side and end clippings and shearings securely bundled with wire to handle with a magnet without falling to pieces, not to exceed 125 pounds in weight, charging box size. No stamping or galvanized scrap or scrap excessively rusted will be accepted.

Compressed Scrap.—Clean steel scrap, clippings and shearings, stamping scrap, tinmill scrap, free from rust, paint or protective coatings, securely compressed in rectangular bundles not larger than 18 inches in any dimension and weighing not less than 75 pounds a cubic foot.

Carbon Steel Co., Piftsburgh, Pa.

Axle Turnings.—Heavy soft steel railroad car axle turnings and chips, no tire and car wheel turnings.

Cast Borings.—Clean, coarse and free from wrought steel and other metals, dirt and lumps.

No. 1 Heavy Melting Steel.—Railroad steel and heavy steel croppings, from rails, billets, blooms, plates, structural shapes, rods, bars, channels, angles, plate shearing from steel plates, (not needle scrap) steel rolls and other similar material. All charging box size not over 6 feet in length or 18 inches in width, and not lighter than one-quarter inch thick. Maximum 300 pounds. No agricultural shapes, grate bars, boiler tubes, cast iron, sheet stock or light stock of any description, or curly or unwieldy pieces will be accepted. Must be clean and free from all dirt and rubbish.

Shoveling Steel.—Strictly new, heavy clean stock, such as railroad track scrap, including bolts, nuts, spikes, etc., boiler and bridge punchings, small crop ends, bolt ends and other similar material. Must be one-quarter inch or over in thickness. No light, tangled material will be accepted.

Carnegie Steel Co., Pittsburgh, Pa.

No. 1 Heavy Melting Steel.—Must be ¼-inch or more in thickness not over 6 feet long and free from pipe busheling. Includes all scrap from industrial steel, railroad scrap in charging box size free from malleable, cast iron or other foreign grades.

Turnings.— Clean machine shop turnings, free from cast iron, slag or lumps, all new, bright turnings.

Cast Iron Borings.—Cast iron machine borings without rough material or lumps, fresh from machine shop.

Central Steel Co, Massillon, O.

No. 1 Railroad Heavy Melting Steel (Specification "A").—To consist of standard section old steel "T" rails, miscellaneous lengths; includ-

ing frog, guard and switch points, rails cut apart, in miscellaneous lengths. The above to be loaded in separate cars and not to be mixed with any other heavy steel scrap with the exception of rails as described above and which are 5 feet and under.

Heavy Steel (Specification "B").—Charging box size, consisting of railroad coil and elliptic springs; no bars of coils to be under one half-inch in diameter; steel draw bars and knuckles, heavy steel croppings from rails, blooms, billets, structural shapes, bars and plates; all to be 5 feet and under in length; three-eighths inch and over in thickness, not exceeding 18 inches in width; minimum weight of any one piece, 10 pounds; maximum weight 300 pounds. Heavy boiler plate three eighths inch and over in thickness, not less than 6 inches wide, or more than 10 inches wide and not exceeding 24 inches in length, but to be free from all scale, will be accepted on this specification. (Country Mixed will NOT be accepted.) All material to be of a character that will go into charging boxes in compact form. All material must be loaded in gondola cars, excepting long length standard old steel railroad rails, which will be accepted if loaded on flat cars.

Heavy Shoveling Steel (Specification "C").—Material not classified under our specification "A" for railroad heavy melting steel. All material must be one-quarter inch in thickness and heavier, 8 inches and shorter in length. Cut pipe and tank, skeleton stock, curly material or cut bedstead scrap will not be accepted under these specifications. All material must be clean, free from dirt or other refuse and burnt material. All material must be loaded in gondola cars.

Commonwealth Steel Co., St. Louis, Mo.

Strictly No. 1 Railroad Heavy Melting Steel.—Charging box size and including "T" rails; miscellaneous lengths, but provided that any frog, guard and switch rails included are cut apart. No cast or pressed steel bolster, structural material or girder rails will be accepted as applying against this order. All material must be shipped in gondola cars.

Crucible Steel Co. of America, Pittsburgh, Pa.

No. 1 Heavy Melting Steel.—Must be charging box size, one-quarter inch and heavier, to include not more than 10 per cent heavy shoveling steel, no piece longer than 6 feet, wider than 24 inches or heavier than 3 tons.

Turnings.—Must be good clean machine shop turnings.

Bundled Sheet.—Side and end sheets from sheet mill, all securely wired with two or three wires.

Compressed Scrap.—Must be hydraulically compressed, bundle-side and end sheet scrap from sheet mill, Logemann bundles or equivalent. All new material to be shipped as produced—not loaded from stock pile.

APPENDIX C

Colorado Fuel & Iron Co., Denver, Colo.

Steel Rails, Scrap.—Any size T-rails, consisting of girder and slot rails, frog, switch and guard rails cut apart, curved and crooked, broken balls and flanges, and any T-rail free from cement and dirt.

Steel Rails.—Consisting of frog, switch and guard rails, uncut.

Heavy Melting Steel, Railroad.—Consists of drawheads, knuckles, couplers, elliptic and coil springs, frog, switch and guard rails cut apart, steel shafting and any heavy melting steel under 5 feet long, no piece less than 10 pounds weight.

Malleable, Railroad.—Any malleable castings from railroads.

Boiler Shop Scrap.—Wrought and steel bars, shape and plate ends, punchings and shearings, free from curly clippings not over 5 feet long or 2 feet wide.

No. 1 Railroad Wrought.—Heavy wrought iron from railroads, ¾-inch or over in diameter, 6 inches or longer, free from steel.

No. 2 Railroad Wrought.—Wrought iron scrap from railroads, under ¾-inch in diameter or 6 inches long, including bolts, nuts, spikes, etc. Free from steel.

Pipes and Flues.—Pipes and flues 5 inches or less in diameter, free from riveted seams and flues, free from dirt and scale, must not be rusted through.

Heavy Melting Steel, Agricultural.—Consists of plow beams, plow shares, steel axles, shafting and other heavy steel from agricultural machinery, free from rake teeth, sickle bars and light, trashy material, no piece less than 5 pounds weight.

No. 1 Country Wrought.—Agricultural wrought scrap, such as rods, bolts and bars, ¾-inch diameter by 6 inches long or longer, including soft steel scrap, wagon tires, buggy and wagon axles, and horseshoes, free from cast, malleable, hard steel, sheet iron and steel, or badly bent or crooked pieces.

Stove Plate.—Must be free from gasoline and steel ranges and drums, and not over 5 per cent grate bars, must not be badly burned.

Mixed Country Scrap.—Iron and steel from agricultural machinery, free from light sheets, tin cans, hoops, corrugated iron, bicycle and bed frames, buggy wheels, uncut traction wheels, tanks, sheets, wire, netting, steel ranges, gasoline stoves, old boilers and any light, trashy material. Sheet iron or steel must be ⅛-inch or heavier and not larger than 2 x 5 feet. Not over 10 per cent pipe.

Agricultural Malleable.—Malleable from agricultural machinery, free from wrought iron or steel and light, trashy material.

Cast Iron.—Railroad and machinery cast iron free from burned cast, in pieces up to 500 pounds.

Agricultural Cast Iron.—Cast iron broken from agricultural machinery, free from wrought iron or steel attachments and burned cast, up to 500 pounds.

Heavy Cast Iron.—Consists of heavy cast iron weighing over 500 pounds to the piece.

Burned Cast Iron.—Grate bars, and any other cast iron badly burned.

Eastern Steel Co., Pottsville, Pa.

No. 1 Heavy Melting Steel.—Specifications generally call for about the same grades as for Coatesville. Material must be one-quarter inch and over in thickness and in chargeable size, viz., pieces not over 6 feet long by 20 inches wide. Cars to be free from tangled country scrap or built-up material. Objects more strongly than Coatesville to shoveling scrap.

Follansbee Bros. Co., Follansbee, W. Va.

Side and End Sheet Scrap.—Must be well bundled, securely wired and not to exceed 125 pounds, per bundle. High silicon scrap prohibited.

Fort Wayne Rolling Mill Corp., Fort Wayne, Ind.

Iron Axles.—Iron railroad car axles; M.C.B. sizes, no locomotive axles or defective or imperfect forgings.

Steel Axles.—Steel railroad car axles; M.C.B. sizes, free from locomotive axles or defective or imperfect forgings.

Iron Rails.—Standard section "T" rails, original weight 50 pounds per yard or heavier, minimum length 4 feet, free from frogs, guards, turntables, switches and curved rails.

No. 1 Railroad Wrought.—Heavy wrought iron from railroad shops and cars, 6 inches and longer, including links and pins.

Shafting.—Iron and soft steel, 1¼ to 6 inches round and square; 4 feet and longer, in straight bars.

No. 1 Wrought.—Heavy wrought iron and soft steel fagoting scrap; bars five-eighths inch to 4 inches, round or square; flats one-quarter inch thick and heavier, 4 inches long or longer, including wagon axles, wagon tires, and horseshoes, exclusive of other shapes or bent pieces. (No steel to be over 0.12 carbon.)

No. 1 Country Wrought.—Heavy wrought iron and soft steel scrap (the latter not over 0.12 carbon), all piling scrap; must be free from hard steel, malleable, mill iron, cast or breakage.

No. 1 Mill.—Iron and soft steel bars, not less than three-eighths inch round or square and flats not thinner than No. 12 wire gauge, including heavy railroad sheet, tank in separate sheets and rings, clean pipes and flues, boiler sheets and rings, heavy punchings and clippings and strictly soft steel agricultural implement shapes. All steel must be under 0.12 carbon.

No. 2 Mill.—Iron and soft steel hoops and sheets, railroad sheet, cotton tie clippings and ties; skeleton sheet scrap and iron too light for No. 1 mill; scrap shall be free from galvanized, tinned or badly rusted material.

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No. 1 Busheling.—Iron and soft steel pipes and flues (clean); boiler plate punchings and clippings and soft steel and iron drop forgings and trimmings; tanks and bands No. 12 and heavier; nothing to be over 8 inches long or wide, free from galvanized or tinned stock. All steel must be under 0.12 carbon.

No. 2 Busheling.—Cut hoops, cotton ties, sheet and similar light material; nothing to be over 8 inches long or wide; bundled sheet suitable for busheling without further preparation; bundles not to weigh over 40 pounds, and not to be over 15 inches in height, width or length; all free from hard steel, malleable and cast, and galvanized or tinned stock.

Turnings.—Machine wrought and soft steel, clean and free from borings and drillings, other metals, dirt and lumps.

Drillings.—Wrought or soft steel, clean and free from other metals, dirt and lumps.

Cast Borings.—Clean and free from other metals, dirt and lumps.

No. 1 Boilers, Cut.—Boiler sheets and rings not under 30 inches in diameter; all rivets cut. Metal not over five-eighths inch thick, nor rings longer than 6 feet.

Boiler and Shipbuilding Shop Scrap.—Wrought and soft steel bar, plate and shape ends, punching and shearings free from curly clippings and hard steel.

No. 1 Cast.—Machinery and railroad cast, no piece to weigh over 75 pounds.

Bundled Sheet Scrap.—New sheet clippings and shearings, securely bundled, bundles not over 15 inches in height, width or length (may be round or square), and weighing not over 40 pounds each of uniform solidity, not pressed by machinery.

Pipes and Flues.—Wrought and soft steel. Must be free from dirt or lime and from riveted seams and malleable or cast iron fittings, also from galvanized scrap.

Gould Coupler Co., Depew, N. Y.

No. 1 Heavy Melting Steel.—Must consist of "T" and girder rails, boiler plates, car springs, splice bars, axles, beams, channels, angles, drawheads, (steel) knuckles, (steel) steel castings, bar mill crops, locomotive tires, all broken to charging box size. Not over 5 feet 4 inches long, 19 inches wide, 27 inches high. Weight not to exceed 600 pounds per piece. No cast iron, wrought iron, malleable iron or tie plates of any sort. No agricultural or country scrap, no wagon shop or blacksmith shop, no boiler tubes, no skeleton scrap, no light scrap of any sort. No old sheared boiler tubes. Must be free from dirt and foreign substances.

Griffin Wheel Co., Chicago, Ill.

No. 1 Cast Scrap.—Railroad machinery or car castings, weight 150 pounds or less. No brake shoes, grate bars, burned iron, iron pipe, stove plate or agricultural implement castings.

No. 2 Cast Scrap.—Castings from agricultural implements, but no brake shoes, burned iron, grate bars, stove plate or iron pipe.

Stove Plate.—Clean stove plate, free from grate bars, sheet iron stoves, steel ranges, burned iron, gas house retorts, annealing pots, kettles or pots.

Cast Borings.—Clean cast iron borings.

No. 1 Brake Shoes.—Plain gray iron brake shoes.

No. 2 Brake Shoes.—Steel back and insert brake shoes.

Railroad Malleable.—Strictly railroad material, no piece except couplers over 150 pounds.

Agricultural Malleable.—Malleable iron castings from agricultural implements, excluding reaper and mower shells, including other small malleable castings, except pipe couplings.

No. 1 Steel.—Railroad steel over 3 feet long, excluding frog, switch and guard rail. Rails 3 feet and under, rail shearing and ajax railroad brace clippings.

No. 2 Steel.—Hard steel, railroad coil and flat springs without plates.

No. 3 Steel.—Rail borings and clips, steel or wrought iron turnings from own shops.

No. 4 Steel.—All kinds of steel castings, steel automatic couplers with straps removed, couplers.

No. 5 Steel.—(A) Heavy melting steel, soft axle ends, structural shapes, merchant bars, no piece over 150 pounds and not more than 10 per cent weighing under 5 pounds, not over 3 feet long and 12 inches wide, or less than ¼ inch in thickness. Will reject sheared materials from old boilers, built-up structural material, wrought iron or sheet steel. (B) Shoveling steel not under ⅛ inch in thickness, steel punchings and small clippings. (C) Steel angle bars. (D) Tie plates and rail braces except ajax rail braces.

Gulf States Steel Co., Birmingham, Ala.

No. 1 Heavy Steel Scrap.—No piece to be over 6 feet in length, 2 feet in width, or 1½ feet in thickness. Steel rods, bars, bolts, pins, piston rods, rail crop, steel forgings, crank pins, connection rods, coil springs, flat springs, horseshoes, buggy springs, switch slides, tie plates, plate clippings, $\frac{A}{16}$ inch in thickness and over, channels, "I" beams, structural steel. Any fabricated material coming within the above limits as to size provided it is free from cast iron. Boiler flues and pipe are not accepted.

No. 2 Mixed Steel Scrap, of Short Lengths.—No piece to be over 6 feet in length, 2 feet in width or 1½ feet in thickness. No car shall contain more than 10 per cent of light material, such as sheet clippings, conveyor chains and buckets, wrought or steel pipe or bundle wire.

No. 3 Mixed Steel Scrap, of Long Lengths.—No car shall contain more than 10 per cent of light material such as sheets, sheet clippings, wrought or steel pipe, conveyor chains and buckets, bundle wire or more

than 10 per cent of riveted car bolsters or other fabricated material exceeding 6 feet in length.

Note.—All fine material, such as horseshoes, bolts, nuts, plate and sheet clippings and punchings, shall be loaded at bottom and at one end of car. If such material is loaded on top it will be sufficient for rejection. Turnings, malleable scrap, cast scrap, car wheels, locomotive tires greater than 30 inches, corrugated iron or any sheet lighter than 20-gage are not within any of the above specifications. Any material not coming within the above specifications, consisting of heavy melting steel, such as channels "I" beams, and structural material, or light material, such as planer chips and steel borings and punchings, we will be glad to bid on when furnished with complete description. Scrap must be loaded in flat bottom gondola cars. The company also buys busheling, specifications same as other mills; and cast iron borings and turnings of good clean stock.

Full carloads material, long straight lengths, under 4 inches and greater than 2 inches in diameter. All lengths straight rails, 40 pounds, sections and heavier. Frogs, switches and guard rails cut apart. Straight bars and axles 2 to 4 inches in diameter.

Highland Iron & Steel Co., Terre Haute, Ind.

Iron Axles.—Iron railroad car axles, M. C. B. sizes, free from locomotive axles or defective or imperfect forgings.

Steel Axles.—Steel railroad car axles, same requirements as for iron axles.

Iron Rails.—Standard section T-rails, original weight 50 pounds a yard or heavier, not less than 4 feet long, free from frog, switch, guard, turntable and curved rails.

Steel Rails.—Same as for iron rails.

No. 1 Railroad Wrought.—Clean wrought iron from railroad equipment, 6 inches or more in length, including rods and bolts ⅝ inch in diameter and over except track bolts, drawbar yokes, bridge iron in bars or rods, switch rods, heavy iron chain, links and pins, free from riveted materials.

No. 2 Railroad Wrought and Track Scrap.—Heavy wrought iron and steel scrap from railroad shops and cars, 2 inches and longer, including track bolts, spikes, nuts, iron channel bars and iron angles and splices.

Shafting.—Iron and soft steel, 1½ inches to 5 inches round or square, 4 feet and longer, straight bars.

No. 1 Wrought.—Heavy wrought iron and steel fagoting scrap, bars ⅝ inch to 4 inches round or square, flat ½ inch thick and heavier, wagon axles, wagon tires, exclusive of bent pieces or other shapes, all suitable for fagoting.

SCRAP METALS

No. 2 Sheared Wrought.—Sheared and short wrought iron and soft steel, not over 24 inches in length, including pieces under 4 inches and heavy punchings.

Country Wrought.—Heavy wrought iron and steel scrap, including buggy tires and horseshoes, not less than 75 per cent to be fagoting stock, free from cast, malleable, hard steel and sheet iron.

No. 1 Country Wrought.—No. 2 sheared wrought and country wrought out of which none of the heavy material has been taken.

No. 1 Mill.—Iron and soft steel bars, not less than ⅜ inch round or square, and flats, including heavy railroad sheet, tanks cut to sheets and rings, not thinner than No. 12 gage, clean pipes and flues, heavy punchings and clippings and strictly soft steel, agricultural implement shapes.

No. 2 Mill.—Iron and soft steel hoops and sheets, railroad sheet, cotton tie clippings and ties, iron too light for No. 1 mill, wire rope, 10-foot lengths and under, wire netting. Free from tinned or galvanized stock, tangled wire and skeleton sheet scrap.

No. 1 Busheling.—Iron and soft steel pipes and flues, tanks and banks, No. 12 gage and heavier, boiler plate punchings and clippings, soft steel and iron drop forgings and trimmings, nothing over 8 inches wide or long, free from galvanized or tinned stock.

No. 2 Busheling.—Cut hoops, sheets, cotton ties and other light material, nothing over 8 inches wide or long, bundled wire and bundled sheet suitable for busheling without further preparation, bundles not over 40 pounds or more than 15 inches wide, high or long, free from hard steel, cast, malleable, galvanized or tinned stock.

Axle Turnings.—Wrought iron and soft steel railroad car axle turnings and chips.

Turnings and Drillings.—Machine wrought and soft steel, clean, free from other metals and lumps.

Mixed Borings and Turnings and Cast Borings.—Clean and free from other metals, dirt and lumps.

No. 1 Boilers, Cut.—Boiler sheets and rings and riveted flues not under 16 inches in diameter, all rivets cut, no single piece to weigh over 500 pounds.

Shop Scrap.—Wrought and soft steel bar, shape and plate ends, punchings and shearings, free from curly clippings and hard steel, all suitable for fagoting.

No. 1 Cast.—Machinery and Railroad Cast.—Machinery and railroad cast, no piece over 75 pounds.

Stove Plate.—Stove plate and locomotive grate bars, free from burned iron.

Bundled Sheet Scrap.—New sheet clippings and shearings, securely bundled, not over 15 inches any measurement, round or square, not over 40 pounds each, uniform solidity, not machine-pressed.

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Pipes and Flues.—Wrought and soft steel not over 16 inches in diameter, free from dirt, lime, malleable or cast iron fittings.

Soft steel mentioned in the above is considered to mean 0.12 carbon and under.

Illinois Steel Co., Chicago, Ill.

Heavy Melting Steel.—Except where specifically excepted pieces must not exceed 6 feet in length, 20 inches in width or thickness and 1000 pounds weight in any single piece. Following grades will not be accepted: Material less than 5 pounds per lineal foot or less than ¼ inch thick, unclean scrap, pieces not reasonably straight, cast and malleable iron and busheling. Will not reject agricultural scrap if properly prepared. No. 2 wrought scrap and any reasonably straight and unburned single pieces of structural steel angles, channels and I-beams, and rails free from cast joints. Must be loaded in open cars with pieces over 6 feet in length loaded separately.

International Harvester Co., Chicago, Ill.

Foundry Cast.—Must contain no wrought iron, grate bars, chilled iron, car wheels, stove plate or steel or malleable. Pieces must not weigh more than 300 pounds. Railroad scrap up to 20 per cent will be allowed.

Inland Steel Co., Chicago, Ill.

No. 1 Railroad Heavy Melting Steel.—To consist of standard section old steel T-rails, miscellaneous lengths, including frog, guard and switchpoint rails cut apart in miscellaneous lengths, loaded in separate cars and not included with other heavy steel, except rails under 5 feet long. Heavy railroad steel scrap, charging box size, including railroad coil and elliptic springs, no bars of coils under ½ inch in diameter, steel drawbars and knuckles, heavy steel croppings from rails, billet blooms, structural shapes, plates and bars, 5 feet and under in lengths, ⅜ inch and over in thickness, not over 18 inches in width, minimum weight any piece 10 pounds, maximum 300 pounds, heavy boiler plate, ⅜ inch and over in thickness, not under 6 or over 10 inches wide or 24 inches in length. All material must be suited to go into charging boxes in compact form and must be loaded in gondola cars, except long lengths of standard steel rails which may be loaded on flat cars.

Heavy Shoveling Steel.—Material not classified under specifications for No. 1 railroad heavy melting steel. All material must be steel or wrought iron, ¼ inch in thickness and heavier, 8 inches and shorter in length. Malleable scrap, cast iron, cut pipe and tank, skeleton stock or curly material will not be accepted under this specification. All material must be clean, free from dirt, other refuse or burnt material, and free from pieces with cast iron or malleable attachments.

SCRAP METALS

Interstate Iron & Steel Co., Chicago, Ill.

Iron Axles.—Iron railroad car axles; M.C.B. sizes free from locomotive axles and defective or imperfect forgings.

Steel Axles.—Steel railroad car axles; M.C.B. sizes free from locomotive axles and defective or imperfect forgings.

Iron Rails.—Standard section "T" rails, original weight 50 pounds per yard or heavier, minimum length 4 feet; free from frog, guard switch, curved and turntable rails.

No. 1 Railroad Wrought.—Heavy wrought iron from railroad shops and cars, 6 inches and longer, including links and pins.

No. 2 Railroad Wrought and Track Scrap.—Heavy wrought iron and sort steel scrap from railroad shops and cars, 2 inches and longer, including track bolts, spikes and nuts.

Shafting.—Iron and soft steel, 1½ inches to 4 inches round and square, 4 feet and longer in straight bars.

No. 1 Wrought.—Heavy wrought iron and soft steel fagoting scrap, bars ⅝ inch to 4 inches round or square; flats one-quarter inch thick and heavier, 4 inches long or longer, including wagon axles, horseshoes and wagon tires, exclusive of other shapes of bent pieces.

No. 1 Country Wrought.—Heavy wrought iron and soft steel scrap, including wagon tires and horseshoes; free from cast, malleable, hard steel, hoops, sheet iron and pipes and flues.

No. 1 Mill.—Iron and soft steel bars, not less than ⅜ inch round or square and flats not thinner than No. 12 wire gage, including heavy railroad sheet, tank in separate sheets and rings, boiler sheets, and rings, clean pipes and flues, heavy punchings and clippings and strictly soft steel agricultural implement shapes.

No. 2 Mill.—Iron and soft steel hoops and sheets; railroad sheet, cotton tie clippings and ties, and iron too light for No. 1 mill; wire rope 10 feet lengths and under; free from galvanized or tinned stock, tangled wire or tangled skeleton sheet scrap.

No. 1 Busheling.—Iron and soft steel pipes and flues (clean) tank and bands No. 12 and heavier, boiler plate punchings and clippings, and soft steel and iron drop forgings and trimmings; nothing to be over 8 inches long or wide, free from galvanized or tinned stock.

No. 2 Busheling.—Cut hoops, sheet, cotton ties and similar light material, all free from hard steel, cast and malleable and galvanized or tinned stock.

Axle Turnings.—Wrought iron and soft steel railroad car axle turnings and chips.

Turnings.—Machine wrought and soft steel, clean and free from borings and drillings, other metals, dirt and lumps.

Drillings.—Wrought or soft steel, clean and free from other metals, dirt and lumps.

Cast Borings.—Clean and free from other metals, dirt and lumps.

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No. 1 Boilers, Cut.—Boiler sheets and rings not under 30 inches in diameter, all rivets cut.

Boiler Shop and Shipbuilding Shop Scrap.—Wrought and soft steel bar, shape and plate ends, punchings and shearings, free from curly clippings and hard steel.

No. 1 Cast.—Machinery and railroad cast, no piece to weigh over 75 pounds.

Stove Plate and Locomotive Grate Bars.—Stove plate and railroad locomotive grate bars, free from burnt iron.

Bundled Sheet.—New sheet clippings and shearings, securely bundled; bundles not over 15 inches in height, width or length (may be round or square), and weighing not over 40 pounds each, of uniform solidity, not pressed by machinery.

Pipes and Flues.—Wrought and soft steel. Must be free from dirt or lime and from riveted seams and malleable or cast iron fittings.

Jones & Laughlin Steel Co., Pittsburgh, Pa.

Heavy Melting Steel.—Structural steel, bars and other heavy steel, straight and not over 18 inches in width nor 6 feet in length. Bloom, billet, structural and rail crops, not exceeding 18 inches in width nor 6 feet in length. Flat boiler or tank, ¼ inch in thickness and heavier, not over 18 inches in width nor 6 feet in length. Rails, frogs, switches and guard rails, cut apart and not exceeding 6 feet in length. Steel knuckles and couplers, coil springs, leaf springs (bands cut), etc. Steel castings, whole or broken up, or when in sizes suitable for charging boxes (6 feet by 18 inches). Rails in miscellaneous lengths will be accepted when loaded in separate cars.

Kansas City Bolt & Nut Co., Kansas City, Mo.

No. 1 Railroad Wrought.—Must be clean wrought iron from railroad equipment; pieces measuring 8 inches long and longer, exclusive of tie plates; may include rods and bolts ½ inch in diameter and over (except track bolts); also draw bar yokes, bridge iron in bars, or rods, heavy iron chain, links and pins. All free from riveted material, limed and mineral, painted or galvanized stock. No body bolsters, engine frames, axle ends, axle butts, engine driver or crank pins.

Cut Heavy Forge.—Wrought iron or soft steel scrap ½ inch to 4 inches round or square; ½ inch thick or thicker; cut in straight pieces 8 inches to 36 inches long. Free from limed, galvanized or painted stock. No hard steel, burned grate bars, or chunky or unwieldy sections, axle butts or ends, or engine driver pins; and no hard steel or reinforcing concrete bars.

Heavy Selected Forge.—Wrought iron or soft steel ⅜ inch to 4 inches round or square; flat ½ inch thick or thicker; and 6 inches long or longer; exclusive of tires and all bent pieces not suitable for fagoting;

free from limed, galvanized or painted stock. No hard steel or burnt grate bars. No pieces too chunky or unwieldy for convenient shearing.

Unsorted Country Dealers, Wrought.—Heavy wrought and soft steel scrap as accumulated from the country; guaranteed to contain at least 60 per cent scrap as heavy as specified in Heavy Selected Forge Class; may include horseshoes, but must be strictly free from mill iron and busheling grades, and from cast, hard steel, malleable, limed, galvanized or painted stock. No reinforcing concrete bars.

Light Country Dealers Wrought.—Light country wrought and soft steel scrap as accumulated from the country from which the heavy material has been sorted. Must not contain any mill iron or busheling grades and be free from cast, malleable, hard steel, limed, galvanized or painted stock; also reinforcing concrete bars.

Tires.—Heavy wagon tires free from wood and rivets; no channel tires.

No. 2 Railroad Wrought.—No. 2 railroad wrought to consist of wrought iron less than 8 inches long, not specified under No. 1 railroad wrought; to include track bolts, rivets, spikes, nuts and lag screws. May include standard iron M.C.B. truck channels, iron angles, or fish plate, but no limed, galvanized or painted stock; also no reinforcing concrete bars.

Cut Wrought.—Cut wrought to consist of iron or soft steel ⅜ inch round or square and larger; flats ¼ x ½ inch or heavier; pieces if straight may be up to 36 inches long; buggy tires must be cut not longer than 4 inches; no horseshoes, channel tires or punchings; free from mill iron and busheling grades, hard steel and pipes; also reinforcing concrete bars.

Iron Axles.—Iron axles to consist of M.C.B. sizes iron car or driving axles, engine truck or tender; free from bent or defective forgings.

Steel Axles.—Steel axles to consist of M.C.B. sizes steel car or driving axles, engine, truck or tender; free from bent or defective forgings.

Iron Car Channels.—Iron car channels to consist of M.C.B. standard iron truck channels, must be reasonably straight and free from mineral paint. Any riveted pieces must have all rivets cut and punched.

Iron Angle and Splice Bars.—Iron angle and splice bars to consist of wrought iron of uniform sizes; not more than 10 per cent broken; not more than 20 per cent fish plates; no patented joints.

Steel Angle and Splice Bars.—Steel angle and splice bars to consist of soft steel of uniform sizes; not more than 10 per cent broken. No patented joints.

Iron Arch Bars and Transoms.—To consist of iron and arch bars and transoms; free from rivets, bolts and castings.

Iron Rails, Heavy.—To consist of standard section scrap iron "T" rails, 50 pounds per yard or heavier; free from guard, frog, switch, turntable or curved rails; reasonably clean and free from fish plates; no pieces under 3 feet long.

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Iron Rails, Light.—To consist of standard section scrap iron "T" rails, 25 pounds per yard or heavier; free from guard, frog, switch, turntable or curved rails; reasonably clean and free from fish plates; no pieces under 3 feet long.

Pipes and Flues.—Pipes and flues to consist of iron or soft steel; ½ inch and larger diameters; nothing shorter than 6 inches; also larger and heavy collars and couplings or protectors. No cast and malleable fittings, coils, fenders, conveyors, galvanized, painted or limed stock. Must be reasonably clean and free from wood; no hard steel pipe.

Shafting.—Shafting to consist of iron or soft steel 1¾ inches and larger in diameter; 3 feet long or longer.

Boiler or Structural Shop Scrap.—To consist of iron or soft steel, boiler, tank or structural punchings and shearings; shapes and plate ends, free from curly clippings and hard steel.

Cut Boilers, Tanks and Fireboxes.—To consist of iron or soft steel boilers, tanks, or fireboxes, cut into separate sheets and rings; not longer nor larger diameter than 6 feet. Crumpled or badly bent pieces not wanted. No boiler heads, domes, crown sheets, burned, heavily limed, heavily painted or galvanized material wanted.

Limed Iron and Steel.—All kinds of iron or soft steel (except flues)—from the interior of boilers which are incrusted with lime, or corroded by the action of water, such as crown bars, crown bar bolts, staybolts, etc.

Horseshoes.—Horseshoes, free from pads and patented horseshoes with screw parts attached.

Uncut Boilers, Fireboxes, Heaters or Tanks.—Nothing under 54 inches in diameter by 7 feet long.

Light Sheet.—To consist of iron or soft steel sheets not thinner than No. 22 gauge. But no badly crumpled or bent pieces. These must be fairly flat and smooth and not less than 1 foot square in area. Heavy skeleton may be included where not more than 50 per cent of the material has been cut away. Also heavy bands and hoops, but tinned, galvanized, or badly rusted material is not wanted. Neither shovels, scoops, stoves or corrugated iron.

Heavy Sheet.—To consist of iron or soft steel sheets, heavier than shown in Light Sheet Class, but must be not less than ¼ inch in thickness, to be fairly flat and smooth and no piece smaller than 1 foot square in area. May include flat tie, bridge, frog, or crossing plates. But no badly crumpled or bent pieces, no burned iron, boiler heads, crown sheets, or domes wanted.

La Belle Iron Works, Steubenville, O.

No. 1 Heavy Melting Steel.—Plate and structural steel shapes, not under ¼ inch thick, not over 20 inches wide nor more than 6 feet long; sheared into such shape that it will lie flat and not be bulky in charging box. Round and square steel bars must not be under ¾ inch in diameter

and be straight enough not to tangle in handling with magnet; all under 2-inch diameter to be sheared to 18 inches and under in length; 2 inches and over to be under 6 feet long. All scrap must be free from dirt, excessive scale and rust or other foreign material.

Heavy Shoveling or Magnet Steel.—Steel bolts, spikes and rod scrap, not less than ½ inch in diameter and not over 12 inches long. Steel plate clippings not under ¼ inch thick and not over 12 inches long; to be sheared into such shape it will lie flat in charging box. Steel punchings not under ¼ inch thick by ¾ inch diameter, or if under ¾ inch diameter thickness must be equal diameter. Steel nuts and similar scrap not under ½ inch thick.

Lackawanna Steel Co., Buffalo, N. Y.

No. 1 Selected Heavy Melting Steel.—Charging box size to consist of miscellaneous steel, ¼ inch in thickness and heavier. All pieces ½ inch thick and heavier to be cut into lengths and widths not to exceed no inches square. Pieces ¼ inch thick to be cut into lengths and widths 10t to exceed 10 inch square. These specifications to include a small percentage of spikes, bolts and nuts and bridge shop punchings and clippings, with the understanding that the punchings and clippings are not less than ¼ inch thick. It is also understood that splice bars, knuckles and couplers, etc., will be accepted on these specifications, but no tie plate and no pipe of any description. Will also accept steel rails of any section in 5-foot lengths and under. Cast steel bolsters cut exactly in half or cut into 3 pieces approximately 30 inches long each and will also accept car trucks and car truck channels if completely cut apart and if sheared into pieces not to exceed 24 inches to 30 inches long; however, it is understood that cast steel bolsters, car trucks and car truck channels so cut and steel rails as described above must be loaded into cars separately and not shipped with other miscellaneous steel.

No. 1 Heavy Melting Steel.—Charging box size to consist of miscellaneous steel ¼ inch in thickness and heavier. All pieces ½ inch thick and heavier to be furnished in pieces not to exceed 20 inches wide by 72 inches long. Pieces ¼ inch thick to be furnished in pieces not exceeding 12 inches wide by 48 inches long. This specification to include spikes, bolts and nuts and bridge shop punchings and clippings with the understanding that the punchings and clippings are not less than ¼ inch thick. No pipe, agricultural scrap, boiler tubes, brake beams or skeleton scrap will be accepted under this classification. All scrap to be evenly loaded in cars so as to be easily handled by use of a lifting magnet. Cars loaded with tangled scrap will not be accepted.

No. 1 Selected Shearing Stock.—To consist of "T" rails in long lengths and girder rails in long lengths free from concrete and cast iron welds, frogs and switches, cut apart.

No. 1 Busheling.—To consist of cut pipe and tank. Under this classification will accept pipe not over 4 inches diameter and cut into

lengths not exceeding 8 inches. Will accept light sheets not under 1/8 inch thick and cut not to exceed 6 inches by 6 inches square.

LaClede Steel Co., St. Louis, Mo.

No. 1 Railroad Steel.—To consist of steel rails and heavy steel railroad scrap frogs, switches and guard rails cut apart, girder rails cut 6 feet or under, free from concrete and welded joints; straight "I" beams and channels, cut 6 feet or under. No piece except railroad rails over 6 feet long by 20 inches wide by 20 inches thick. Railroad rails under 45 pounds per yard unless cut to 6-foot lengths. No piece weighing less than 10 pounds. As far as possible material over 6 feet to be loaded separate from material cut to size. To be loaded in open cars.

Lebanon Valley Iron & Steel Co., Lebanon, Pa.

Wrought Iron and Soft Steel Shafting.—Free from hubs and collars, nothing under 1¼ inch in diameter, or over 5½ inches in diameter and nothing over 30 inches long.

Black Pipe.—Not over 5 per cent, nor under 1 inch in diameter.

Cut Light Iron.—Free from galvanized or painted stock.

Uncut Light Iron.—Free from galvanized or painted stock. Company also purchases No. 1 railroad wrought, No. 2 wrought iron, wrought iron and soft steel turnings and cast borings, but the exact specifications on these are not given.

Lockhart Iron & Steel Co., Pittsburgh, Pa.

No. 1 Railroad Wrought.—Links, bars, rods, pins and all heavy iron from railroad shops and cars, 8 inches and longer. Unsheared.

No. 2 Railroad Wrought.—Track bolts, spikes, channel bars, nuts and mixed angle bars.

Shafting.—Iron and soft steel 2 inches to 5 inches round or square; 4 feet and longer in straight bars, free from collars or castings.

No. 1 Wrought.—Bars 5/8 to 4 inches round or square; flats ¼ inch thick and heavier; all 4 inches long or longer; exclusive of wagon or buggy tires, shapes and all bent pieces not suitable for fagoting. Sheared.

No. 1 Country Wrought.—Iron and soft steel bars and rods, wagon tires, axles and horseshoes; not less than 75 per cent to be fagoting scrap and horseshoes, free from cast, malleable, hard steel and sheet iron. Unsheared.

No. 1 Mill.—Iron and soft steel bars, not less than 3/8 inch round or square, and flats not thinner than No. 12 wire gauge; tank in sheets and rings, crown bars, pipes and flues (cleaned and free from lime), punchings and clippings. May be 8 inches and less. Unsheared busheling No. 1.

No. 2 Mill.—Iron and soft steel hoops and sheets, cotton tie clippings and ties, and iron to light for No. 1 Mill; wire rope 10 feet lengths

and under, wire netting free from galvanized and tinned stock, tangled wire and skeleton sheet scrap. Unsheared busheling No. 2.

No. 1 Busheling.—Iron and soft steel pipes and flues (clean) tank and bands No. 12 and heavier, boiler plate punchings and clippings, and soft steel and iron, spoiled drop forgings and trimmings; nothing to be over 8 inches long or wide; free from galvanized or tinned stock.

No. 2 Busheling.—Cut hoops, sheet cotton ties and similar light material; nothing to be over 8 inches long or wide; bundled wire and bundled sheet, suitable for busheling without further preparation; bundles not to weigh over 40 pounds, and not to be over 15 inches square; all free from hard steel, malleable and cast, and galvanized or tinned stock.

Turnings.—(a).—Iron car axles turnings and chips, (b) soft steel car axle turnings and chips, (c) machine wrought and soft steel, clean and free from borings and drillings, other metals, dirt and lumps.

Drillings.—Wrought or soft steel, clean and free from other metals, dirt and lumps.

Cast Borings and Drilling.—Clean and free from other metals, dirt and lumps.

Mixed Borings and Turnings.—Clean and free from other metals, dirt and lumps.

No. 1 Boilers, Cut.—Sheets and rings; rings to be 30 inches in diameter and over, and rivets cut at all seams.

No. 2 Boilers, Cut.—Under 30 inches diameter and riveted flues, 16 inches and less.

Boiler and Car Scrap.—Bar and shape ends, punchings and shearings free from curly clippings and hard steel.

No. 1 Cast.—Machinery and R. R. cast, no piece to weigh over 75 pounds.

No. 2 Cast.—Stove plate and railroad locomotive grate bars free of burnt iron.

Lukens Steel Co., Coatesville, Pa.

No. 1 Heavy Melting Steel Long.—Straight rails over 5 feet frog, switch and guard rails cut apart; straight structural up to 12 inches wide and over 5 feet long, cut apart; straight bars and axles from 1 foot to 4 feet.

No. 1 Heavy Melting Steel Short.—Heavy railroad steel in charging box shape, rails, bloom billet and structural crops under 5 feet in length and 500 pounds in weight, flag boiler plate ¼ inch and heavier, cut in charging box sizes, not over 20 inches wide and 5 feet long, structural material, straight, not over 5 feet long.

No. 2 Steel.—Cut yard scrap ¼ inch thick and heavier, all charging box shape, heavy punchings, skate scrap and all good heavy clean shoveling scrap; no light, tangled or badly rusted scrap included.

No. 3 Steel.—Bundled sheets in compressed packages, light shoveling, bundled skeleton.

No. 4 Steel.—Frogs and switches not cut apart, structural material not cut apart, flat boiler plate not cut and other material of similar shape.

Note.—No mixed cars of scrap, (that is long and short), will be received except by special agreement in writing. Where short scrap and shoveling are in same car, the shoveling must be in one end or bottom of car. Heavy turnings, malleable railroad, detinned billets, car wheels, both iron and steel, cast iron scrap, all are special and not within any above specification.

Midvale Steel Co., Cambria Steel Co., Worth Bros. Co., Wilmington Steel Co., Philadelphia, Pa.

No. 1 Heavy Melting Steel.—Railroad steel, heavy steel croppings from billets, blooms, rails, structural shapes, plates, rods, channels, bars, angles, plate shearings, steel rolls and similar material. Material must be charing box size, not over 6 feet long or 18 inches wide, and not lighter than ¼ inch thick. No piece must weigh less than 10 pounds or more than 300 pounds. Will not accept agricultural shapes, boiler tubes, grate bars, cast iron, sheet stock or light stock, curly or unwieldy pieces. All must be clean and free from all dirt and rubbish.

For the Brandywine works the following is provided: Heavy melting steel—steel scrap from materials ¼ inch thick or heavier, free from tinned, painted or galvanized material, light sheets, pipe, wire rope, mine rails, cast or malleable iron, light shoveling stock, electrical scrap, agricultural scrap and horseshoes. Must not exceed 5 feet long and 20 inches wide, of charging box shape. Must be shipped in open cars.

For the Valley and Viaduct mills the special specification is as follows: Forge fire—soft steel drop forge trimmings of light classification; soft steel bundled sheet scrap from stamping; cotton ties in bundles not over 30 inches long, weighing not more than 40 pounds a bundle; soft steel skeleton scrap in coils like belting, not over 24 inches in diameter and 40 pounds in weight a bundle; other desirable scrap guaranteed absolutely free from tinned, painted or galvanized material, cast or malleable iron, brass, copper, electrical scrap, or other metals, all to be suitable for use in forge fires.

Montour Rolling Mill Co., Danville, Pa.

No. 1 Wrought.—Wrought iron car and blacksmith scrap, ¼ inch and heavier, bolts 6 inches and longer, free from heavy and bulky pieces which cannot be sheared by ordinary means, free from steel.

No. 1 Cast.—Car and road castings, broken to 1-man size, free from steel, malleable and burned cast or pieces larger than 1-man size.

Iron Axles.—Wrought iron car axles only, engine truck axles excluded.

No. 2 Wrought.—Light colliery plates, sheets and screens only.

Car Wheels.—Standard chilled cast iron cast wheels, mine car wheels, excluding steel wheels.

Wrought Iron Turnings.—Wrought iron and soft steel turnings and borings mixed, clean, free from lumps and foreign material, brass, copper, babbitt and lead.

Cast Iron Borings.—Clean, new cast iron borings, free from wrought iron and steel, lumps, brass, copper, babbitt.

Burned Cast.—Locomotive grate bars and rests.

National Enameling & Stamping Co., New York

No. 1 Railroad Steel.—To consist of steel rails and heavy railroad scrap frogs, guards and switch rails cut apart. Girder rails cut 6 feet or under, absolutely free from concrete and welded joints; straight "I" beams and channels, cut 6 feet or under. No piece except railroad rails over 6 feet long by 20 inches wide by 20 inches thick. Railroad rails under 45 pounds per yard, unless cut to 6-foot lengths. No piece weighing less than 10 pounds. As far as possible material over 6 feet to be loaded separate from material cut to size. All loaded in open cars.

Shoveling Steel Scrap.—Tank Band, No. 12 and heavier, boiler plates, punchings and clippings and steel drop forgings and trimmings, and any good heavy shoveling steel. Nothing to be over 12 inches by 12 inches, nor lighter than 12 gage. Must contain no light, tangled, bulky or badly rusted scrap, no cast or malleable iron, and must be free from galvanized or tinned steel; and no steel pipe, flues or tubes of boilers will be accepted. Car must be swept clean before loaded and must be loaded in open cars.

Otis Steel Co., Cleveland, O.

No. 1 Heavy Melting Steel.—Specification generally along lines of other mills, charging box size 6 feet long and 18 inches wide.

Pittsburgh Steel Co., Pittsburgh, Pa.

Heavy Melting Steel.—All heavy melting steel, strictly No. 1 comprising heavy railroad steel including "T" girder and tram rails, cut not over 6 feet long; drill stems, bits and jars; steel rolls; plate ¼ inch and over; heavy crop ends; heavy structural steel; heavy clean mashed pipe; plate shearings ¼ inch thick and over, excluding needle scrap; heavy rounds, squares and flats. Must be charging box sizes, the size of box being 72 inches by 24 inches by 22 inches.

"T" Girder and Tram Rails.—To be clean of miscellaneous lengths and with or without cast welds.

Shoveling Steel.—Consisting of spikes, bolts, nuts, tie plates, blacksmith shop scrap, structural and boiler punchings; horseshoes or similar heavy shoveling steel and shoveling crop ends. All must be clean and no light or tangled scrap to be included.

Selected Agricultural Steel.—Consisting of clean heavy steel, such as cutter bars, harrow seats, discs, steel plow points, and beams.

Wagon and buggy springs and tires, and other similar heavy material. All must be charging box sizes, the size of box being 72 inches by 24 inches by 22 inches.

Black Bundled Sheets.—Consisting of side and end scrap, all to be new material from sheet and tin plate mills, tightly bundled and securely tied with wire. All must be charging box sizes, the size of box being 72 inches by 24 inches by 22 inches.

Black Bundled Sheets.—Consisting of side and end scrap, all to be new material from sheet and tin plate mills. Hydraulically pressed.

De-Tinned Sheet Scrap.—Must be free from tin and galvanizing and in hydraulically pressed bundles.

Shoveling Crop Ends.—Consisting of sheet rimmings, punchings and stamping works scrap, free from paint or galvanizing.

Heavy Steel Turnings.—Consisting of turnings from car axles and other heavy forgings, to be clean and free from rust, lumpy stock or foreign material, and must not be mixed with iron borings.

Machine Shop Turnings.—Must be clean and free from rust, oil, lumpy stock or foreign materials and must not be mixed with iron borings.

Borings, Steel or Iron.—Must be clean and free from oil, rust, lumpy stock or foreign materials.

Cast or Wrought Steel Bolsters.—Must be without straps and other projecting places.

New Pipe Scrap Not Mashed.—Must be 4 inches and under, clean and free from galvanizing and other foreign materials, must not exceed 6 feet in length.

Malleable Iron Scrap.—Consisting of malleable car and engine castings, couplers, knuckles, clean agricultural malleable castings and pipe couplings. All must be charging box sizes, the size of box being 72 inches by 24 inches by 22 inches.

No. 1 Busheling Scrap.—Consisting of pipe, plate and short steel scrap; to be free from dirt, galvanizing and foreign materials.

The Pullman Co., Chicago, Ill.

Follows the Railway Storekeepers' association specifications except that it buys shafting 1½ to 4 inches in diameter, straight and free from collars and flanges.

Republic Iron & Steel Co., Youngstown, O.

Iron Axles.—Iron railroad car axles, M. C. B. sizes, free from locomotive axles or defective or imperfect forgings.

Steel Axles.—Steel railroad car axles, M. C. B. sizes, free from locomotive axles or defective or imperfect forgings.

Iron Rails.—Standard section T-rails, original weight 50 pounds a yard or heavier, minimum length 5 feet, free from frogs, guards, switches, turntable and curved rails.

SCRAP METALS

Steel Rails.—Standard section T-rails, suitable for rerolling, original weight 50 pounds a yard or heavier, minimum length 5 feet, free from split heads, frogs, guards, switches, curved and turntable rails.

A No. 1 Railroad wrought.—Heavy wrought iron from railroad shops and cars, 6 inches and longer, including iron links and pins.

B No. 2 Wrought.—Heavy wrought iron and soft steel scrap from railroad shops and cars, 2 inches long, 2 inches wide or wider, and longer, including track bolts, nuts and spikes, iron angle bars and plain splices, free from patent joints, steel angles and splices, steel channel bars and plate material.

B—X Cut Forge.—Iron and soft steel scrap suitable for piling purposes without further preparation. Material to be ⅜-inch or heavier, 4-inch or narrower and not over 26 inches in length or shorter than 2 inches. May include wagon tire if cut into 6-inch lengths or shorter; also horseshoes if cut into three pieces. Must be straight and flat; also free from plate, sheet, hoop and washer scrap, punchings and similar material.

C—Shafting.—Iron and soft steel, 1½ inch to 4 inches round and square, 4 feet and longer, in straight bars.

D—No. 1 Wrought.—Heavy wrought iron and soft steel fagoting scrap, bars ⅝ inch to 4 inches round or square, flats ¼ inch thick and heavier, 4 inches long or longer, including wagon axles, horseshoes and wagon tires, exclusive of other shapes or bent pieces.

E—No. 1 Country Wrought.—Heavy wrought iron and soft steel scrap (the latter not over 0.12 carbon), including buggy tires, horseshoes; all fagoting scrap.

F—No. 1 Mill.—Iron and soft steel bars not less than ⅜ inch round or square, and flats not thinner than No. 12 wire gage, including heavy railroad sheet; tank in separate sheets and rings, boiler sheet and rings, clean pipe and flues, heavy punchings and clippings and strictly soft steel agricultural implement shapes. All steel must be under 0.12 carbon.

G—No. 2 Mill.—Iron and soft steel hoops and sheets, railroad sheet, cotton tie clippings and ties, skeleton sheet scrap and iron too light for No. 1 mill; scrap shall be free from galvanized, tinned or badly rusted material.

H—No. 1 Busheling.—Iron and soft steel pipes and flues (clean); tank bands No. 12 and heavier, boiler plate punchings and clippings, and soft steel and iron drop forgings and trimmings; nothing to be over 8 inches long or wide, free from galvanized or tinned stock. All steel must be under 0.12 carbon.

I—No. 2 Busheling.—Cut hoops, sheet, cotton ties and similar light material; nothing to be over 8 inches long or wide; free from dirt, galvanized or tinned material, or other similar inferior scrap.

J—K—Axle Turnings.—Wrought iron and soft steel railroad car axles, turnings and chips. Free from tire turnings.

L—Turnings.—Machine wrought and soft steel, clean and free from borings and drillings, other metals, dirt, lumps and badly tangled material.

M—Drillings.—Wrought or soft steel, clean and free from other metals, dirt and lumps.

N—O—Mixed Borings and turnings, and cast Borings.— Clean and free from other metals, dirt and lumps.

P—Pipes and Flues.—Wrought and soft steel. Must be free from dirt or lime and from riveted seams; nothing over 6 inches in diameter.

Q—No. 1 Heavy Melting Steel.—Railroad steel and heavy steel croppings from rails, billets, blooms, structural shapes, plates, bars, rods, channels, angles, plate shearings from steel plates—not needle scrap—steel rolls and other similar material. All charging box size not over 6 feet in length or 18 inches wide and not lighter than ½ inch thick. Minimum weight 10 pounds, maximum 300 pounds. No agricultural shapes, boiler tubes, grate bars, cast iron, sheet stock or light stock of any description, or curly or unwieldy pieces will be accepted. All must be clean and free from all dirt and rubbish.

R—Shoveling Steel.—Strictly new heavy clean stock such as railroad track scrap including spikes, bolts, nuts, etc., boiler and bridge punchings and clippings, small crop ends, bolt ends and other similar material. All must be ¼ inch or over in thickness and no light tangled material will be accepted.

S—Bundled Sheet Scrap.—Strictly new side and end clippings and shearings, well bundled, securely wired and not to exceed 125 pounds, to be in charging box size. No stamping scrap will be accepted.

Rockaway Rolling Mill Co., Rockaway, N. J.

Long New York City—Wrought Scrap.—Rounds and squares, ½ inch and larger in diameter, flats 1 inch by ¼-inch and heavier, 8 inches and longer. Will not accept horseshoes, cast and malleable, hard steel and hub bands.

Sellers Mfg. Co., Chicago, Ill.

No. 1 Railroad Wrought.—Heavy wrought iron from railroad shops and cars, 6 inches and longer, including iron links and pins.

No. 2 Wrought.—Heavy wrought iron and soft steel scrap from railroad shops and cars, 2 inches long, 2 inches wide or wider and longer, including track bolts, nuts and spikes, iron angle bars and plain splices, free from patent joints, steel angles and splices, steel channels bar and track spikes.

Cut Forge.—Iron and soft steel scrap suitable for piling purposes without further preparation. Material to be ⅜ inch or heavier, 4 inches of narrower and not over 26 inches in length or shorter than 2 inches. May include wagon tires if cut into 6-inch lengths or shorter; also horse-

shoes if cut into 3 pieces. Must be straight and flat; also free from sheet, plate, hoop and washer scrap, punchings and similar material.

Shafting.—Iron and soft steel 1½ inches to 4 inches round or square, 4 feet and longer in straight bars.

Wrought.—Heavy wrought iron and soft steel fagoting scrap, bars ⅝ inch to 4 inches round or square, flats ¼ inch thick and heavier, 4 inches long or longer, including wagon axles, horseshoes and wagon tires, exclusive of other shapes or bent pieces.

No. 1 Busheling.—Iron and soft steel pipes and flues (clean) tank and bands No. 12 and heavier, boiler clippings, and soft steel and iron drop forgings and trimmings; nothing to be over 8 inches long or wide, free from galvanized or tinned stock. All steel must be under .12 carbon. No punchings or washer scrap accepted.

Turnings.—Machine wrought and soft steel, clean and free from forgings, other metals, dirt, lumps, snarly and badly tangled material.

Iron Rails.—Standard section "T" rails, suitable for rerolling, original weight 50 pounds per yard or heavier, minimum length 5 feet, free fron split heads, frogs, guards, switches, curved and turntable rails.

Bridge Iron.—Only iron, bridge, angles, channels and plates, thickness ⅜ inch and over, length 3 feet and under 30 feet, width 6 inches and under 48 inches. Material to be free from rivets, fastenings, bent, torn, twisted and curved pieces.

Sharon Steel Hoop Co., Sharon, Pa.

Heavy Melting Steel.—Charging box size, not over 5 feet long or 18 inches wide, light material, ¼ to ½ inch thick, must be new stock and cut to busheling size.

St. Louis Screw Co., St. Louis, Mo.

Iron Axles.—Railroad car and locomotive axles, free from defective or imperfect forgings.

Iron Rails.—Standard section "T" rails, original weight 50 pounds per yard or heavier, minimum length 5 feet free from frog, switch, guard, bent, curved and circle rails.

Steel Rails.—Standard section "T" rails, original weight 50 pounds per yard or heavier, minimum length 5 feet free from frog, switch, guard, bent, curved and circle rails.

Shafting.—Iron and soft steel 1½ inches to 5 inches round and square, 2½ feet and longer, in straight bars.

Arch Bars and Transoms.—Standard railroad iron arch, transom and tie bars.

Iron Angle Bars.—Standard railroad iron angle splice bars, free from continuous or patented joints.

Steel Angle Bars.—Standard railroad steel angle splice bars, free from continuous or patented joints.

Bridge Iron.—Iron bridge angles, channels, plates and eye bars, ⅜ inch and thicker, 3 feet and longer, 4 inches to 36 inches wide and

free from rivets and fastenings and from badly bent, twisted, torn or curved pieces.

Engine Frames.—Iron engine frames, all bolts cut.

No. 1 Railroad Wrought.—Clean wrought iron from railroad equipment, pieces measuring 4 inches long and over (exclusive of threads) may include rods and bolts ⅜ in diameter and over (except track bolts), also drawbar yokes, bridge iron in bars or rods, switch rods, heavy iron chain, links and pins; free from riveted material.

No. 2 Railroad Wrought.—Heavy wrought iron and soft steel scrap from railroad shops and cars, 2 inches and longer, including track spikes, bolts and nuts, rivets, iron angle bars, lag screw, and splices, free from patented joints and plate material.

No. 1 Wrought.—Heavy wrought iron and soft steel scrap, round or square bars ⅜ inch to 4 inches; flat bars ¼ inch thick and heavier, 4 inches long or longer, including wagon axles and wagon tires, exclusive of other shapes or bent pieces all suitable for fagoting purposes.

Cut Forge.—Sheared and short wrought iron and soft steel, not over 26 inches in length, to conform to No. 1 wrought, except that wagon tires must be cut into 6-inch lengths or shorter, and heavy punchings and pieces shorter than 4 inches may be included. All material to be suitable for fagoting purposes without further preparation.

Shop Scrap.—Wrought and soft steel bars, shape and plate ends, punchings and shearings, free from curly clippings and hard steel all suitable for fagoting.

No. 1 Country Wrought.—Heavy wrought iron and soft steel scrap, including buggy tires, horseshoes, not less than 72 per cent to be fagoting scrap, free from malleable, cast, hard steel and sheet iron.

No. 1 Busheling.—Iron and soft steel pipes and flues, (clean) tank and bands No. 18 and heavier, boiler plate punchings and clippings, and soft steel and iron drop forgings and trimmings; nothing to be over 8 inches long or wide, free from galvanized or tinned stock.

Pipes and Flues.—Wrought iron and soft steel not over 8 inches in diameter, free from dirt and lime.

No. 1 Boiler.—Boiler sheets and rings and riveted flues not under 16 inches in diameter, all rivets cut, no single piece to weigh over 500 pounds.

Heavy Railroad Sheet.—¼ inch and over, including boiler, tank and firebox steel and iron, cut up, bridge plates, frog and crossing plates.

No. 1 Railroad Light Sheet.—Under ¼ inch, consisting of cut smoke stacks, wire rope, (not galvanized) hoops, netting, hand iron and steel, pressed steel hand car wheels, scoops, iron wire, shovels, free from galvanized iron and tin.

No. 1 Mill.—Wrought iron and soft steel bars, heavy railroad sheet, tank in separate sheets and rings, boiler sheets and rings, all No. 12 and heavier, all rivets cut heavy punchings, and clippings and strictly soft steel agricultural implement shapes.

No. 2 Mill.—Iron and soft steel hoops and sheets, railroad sheet, cotton tie clippings and ties and iron too light for No. 1 Mill, wire rope 10 feet long and under, wire netting. Free from galvanized or tinned stock, tangled wire and skeleton sheet scrap.

Bundled Sheet Scrap.—New sheet clippings and shearings, securely bundled; bundles not over 15 inches in height, width or length (may be round or square); and weighing not over 40 pounds each of uniform solidity, not pressed by machinery.

Axle Turnings.—Railroad car axle turnings and chips.

Turnings and Drillings.—Machine wrought iron and soft steel, clean and free from other metals, dirt and lumps.

Cast Iron Borings.—Clean and free from other metals, dirt and lumps.

Mixed Borings, Turnings and Drillings.—Wrought iron, soft steel and cast iron, clean and free from other metals, dirt and lumps.

No. 1 Cast.—Machinery and railroad cast, no piece to weigh over 75 pounds.

Note.—Soft steel herein mentioned is considered to mean .12 carbon and under.

N. & G. Taylor Co., Philadelphia, Pa.

No. 1 Heavy Melting Steel.—Under 5 feet in length and 18 inches in width, 1-man pieces not lighter than 5 pounds each. This company buys No. 1 railroad and machinery cast on the same specifications.

Texas Rolling Mill Co., Fort Worth, Tex.

Iron Axles.—Iron railroad car axles; M.C.B. sizes, free from locomotive axles or defective or imperfect forgings.

Steel Axles.—Steel railroad car axles; M.C.B. sizes; free from locomotive axles or defective or imperfect forgings.

Iron Rails.—Standard section "T" rails, original weight 50 pounds per yard or heavier, minimum length 4 feet free from frogs, switches, guards, turntables and curved rails.

Steel Rails.—Standard section "T" rails, suitable for rerolling, original weight 50 pounds per yard or heavier, minimum length 3 feet free from split heads, frogs, switches, guards, turntable and curved rails.

No. 1 Railroad Wrought.—Heavy wrought iron from railroad shops and cars, 6 inches and longer, including links and pins.

No. 2 Railroad Wrought.—Heavy wrought iron and soft steel scrap from railroad shops and cars, 2 inches and longer, including track bolts, spikes, nuts, iron angle bars and splices (free from channel bars and steel angles and splices).

Shafting, Iron and Soft Steel.—1¾ to 4 inches round and square; 2 feet and longer in straight bars.

Dealers' Wrought.—Heavy wrought iron and soft steel fagoting scrap, bars ⅝ inch to 4 inches, round or square; flats ¼ inch thick

and heavier, 4 inches long or longer; including wagon axles and wagon tires, exclusive of other shapes or bent pieces.

Country Wrought.—Heavy wrought iron and soft steel scrap (the latter not over 0.12 carbon), not less than ⅜ round or square, flats and sheets not thinner than ⅛, including buggy tires, horseshoes, pipe and flues, strictly soft steel agricultural implement shapes and similar material, and to be strictly free from cast and malleable scrap, hard steel and other material.

No. 1 Mill.—Iron and soft steel bars, not less than ⅜ inch round or square and flats not thinner than No. 12 wire gauge, including heavy railroad sheet, tank in separate sheets and rings, boiler sheets and rings, clean pipes and flues, heavy punchings and clippings and strictly soft steel agricultural implement shapes. All steel must be under 0.12 carbon.

No. 2 Mill.—Iron and soft steel hoops and sheets, railroad sheet, cotton tie clippings and ties, skeleton sheet scrap and iron too light for No. 1 Mill; scrap shall be free from galvanized tinned or badly rusted material.

No. 1 Busheling.—Iron and soft steel pipes and flues (clean) tank and bands, No. 12 and heavier, boiler plate punchings and clippings, and soft steel and iron drop forgings, and trimmings; nothing to be over 8 inches long or wide, free from galvanized or tinned stock. All steel must be under 0.12 carbon.

No. 2 Busheling.—Cut hoops, sheet cotton ties and similar light material; nothing to be over 8 inches long or wide, bundled sheet suitable for busheling without further preparation, bundles not to weigh over 40 pounds, not to be over 15 inches in height, width or length; all free from hard steel, cast and malleable and galvanized or tinned stock.

Axle Turnings.—Wrought iron and soft steel railroad car axles turnings and clips. Free from tire turnings.

Turnings.—Machine wrought and soft steel, clean and free from borings and drillings, other metals, dirt and lumps.

Mixed Borings and Turnings and Cast Borings.—Clean and free from other metals, dirt and lumps.

No. 1 Boilers, Cut.—Boiler sheets and rings not under 30 inches in diameter, all rivets cut. Metal not over ¾ inch thick.

No. 2 Boilers, Cut.—Boiler sheets and rings under 30 inches in diameter, and riveted flues, not under 16 inches in diameter, all rivets cut. Metal not over ¾ inch thick.

Boiler and Shipbuilding Shop Scrap.—Wrought and soft steel bar shape and plate ends, punchings and shearings, free from curly clippings and hard steel.

Bundled Sheet.—New sheet clippings and shearings, securely bundled; bundles not over 15 inches in length, width or height (may be round or square) and weighing not over 40 pounds each, of uniform solidity, not pressed by machinery.

Pipes and Flues.—Wrought and soft steel. Must be free from dirt or lime and from riveted seams and malleable or cast iron fittings.

United Alloy Steel Corp., Canton, O.

No. 1 Heavy Melting Steel Scrap.—Material furnished under this specification must be strictly No. 1 heavy melting steel scrap, or wrought iron, in charging box size, (not over 5½ feet in length and 2 feet in width). Shall consist of heavy steel croppings from rails, billets, blooms, structural shapes, plates and bars, and other manufactured steel ¼ inch in thickness and over. The following material may also be furnished under these specifications: old rails of any section (except mine rails) beams, channels, angles, structural shapes, shafting, bars and rods, all ¼ inch in thickness and over. All to be in charging box size. The material must be clean, free from all dirt and rubbish, and free from all stock showing excessive rust. Material must be free from brass, copper or alloys undesirable for remelting. Must be free from unwieldy or curly pieces, or stock that will not handle to good advantage. No cut pipes, sheet stock, flues or light stock of any description will be accepted. New heavy shoveling stock, such as boiler and bridge punchings or other heavy punchings and clippings, may be furnished. No shoveling stock will be accepted, which is not clean, new stock. All shoveling stock must be ¼ inch or over in thickness.

United Engineering & Foundry Co., Pittsburgh, Pa.

Basic Open Hearth Steel.—To consist of billets, blooms, or axle butts, also heavy punchings and rivets, guaranteed not to exceed .04 in phosphorus and sulphur; bloom ends to be suitable for charging boxes, 45 inches by 18 inches by 17 inches.

Heavy Cast.—Suitable for air furnace practice, cupola cast scrap, standard railroad car wheels, pit car wheels, and steel knuckles and couplers.

Upson Nut Co., Cleveland, O.

No. 1 Railroad Heavy Melting Steel.—Must be charging box size.

No. 1 New Shop Steel.—Must be charging box size, consisting of punchings, clippings and other good heavy material, ¼ inch and thicker.

The company also buys No. 1 heavy melting and shoveling steel made by dealers, short machine shop turnings, heavy axle turnings and new hydraulic black sheet compressed bundles. It accepts material on practically the same basis as other Youngstown consumers.

Washburn Wire Co., Phillipsdale, R. I.

Heavy Melting Steel.—Not over 5 feet long and 12 inches wide and high, structural steel and rails, boiler plate and punchings, heavy plate,

skeleton scrap and heavy steel. Light iron turnings, malleable and cast iron are not accepted.

West Leechburg Steel Co., West Leechburg, Pa.

No. 1 Heavy Melting Steel.—Either structural material or plate, cut to charging box size, 4 feet and under, clean material, new preferred.

Wrought Pipe.—Must be new and cut to charging box size, 4 feet and under, clean material.

Turnings.—Heavy, clean material such as axle and forge turnings.

West Penn Steel Co., Brackenridge, Pa.

Machine Shop Turnings.—Must be clean.

Heavy Machinery Cast.—Must be breakable under a drop.

Scrap Rolls.—Not over 36 inches in diameter.

The company also purchases carwheels.

Whitaker-Glessner Co., Portsmouth, O.

No. 1 Heavy Melting Steel.—Rails not to exceed 6 feet in length crop ends, plate ¼ inch and heavier, punchings, spikes and rivets (not to exceed 20 to 25 per cent of the contract), rounds and squares ½ inch and heavier. All material to be in charging box size. Any other material as No. 1 heavy melting steel must be shipped at the seller's risk.

Bundled Sheet.—Consisting of new black sheet steel shearings from a sheet or plate mill, securely bound with wire into bundles of charging box sizes; shearings from black sheet from electric or stamping works, bundled in a compressor into bundles not to exceed 24 inches square. Cars are to contain absolutely no loose material of any nature. Also to be free from rusty stock, tinned or galvanized material.

No. 1 Shoveling Steel.—Material to consist of nuts, bolts, bars ends, spikes, crop ends and heavy punchings and clippings; no pieces to be less than ½ inch in length and ½ inch to ¾ inch in diameter or equivalent size.

Loose Sheet.—Material to be new black sheet steel scrap not over 2 feet long, free from paint, enamel, galvanized iron, rust, tin or any other foreign substance.

No. 1 Busheling.—Cut pipe and tank, horseshoes, boiler plate punchings and clippings, drop forgings and trimmings ⅛ inch thick or heavier and not over 8 inches long. Tinned, enameled, galvanized iron, painted or any other coated or excessively rusted or dirty stock, will not be accepted.

Cast Iron Borings.—Material to be new, clean, free from oil, lumps, rust, brass, scale, or any other foreign substance.

Machine Shop Turnings.—Material to be clean, new, free from cast iron borings, lumps, brass, rust, dirt and other foreign substance.

SCRAP METALS

Wickwire Bros., Cortland, N. Y.

No. 1 Railroad Heavy Melting Steel.—Must be charging box size, rail crops, axle ends, angle splice bars, side rods, crank pins, track bolts and spikes, No. 2 wrought and steel will be accepted in limited quantities.

Alan Wood Iron & Steel Co., Philadelphia, Pa.

No. 1 Heavy Melting Steel.—Heavy railroad steel scrap, chargeable material ½ inch or more in thickness, not over 20 inches high or wide and 6 feet in length, excluding all light scrap, cast and malleable.

Youngstown Sheet & Tube Co., Youngstown, O.

Bridge Scrap.—No material other than plates, eye-bars, I-beams, angles and channels accepted. Must be cut apart and free from rivets and bolts. Plates must be at least $\frac{3}{16}$ inch thick, channels and I-beams not less than 6 inches wide nor 3 feet long. Angles must be at least 4 inches wide on one flange and not under 3 feet long. Eye-bars must be flat and straight. Must be free from curves or twisted material or bent or mashed flanges and must be sheared clean. Only strictly wrought iron accepted.

Tank Plates.—Flat, free from rivets, $\frac{3}{16}$ inch thick or over, entirely cut apart, strictly wrought iron.

Piling Plates.—From No. 8 gage to ½ inch thick, free from rivets, flat, 5 to 20 inches wide, 18 to 24 inches long, strictly wrought iron.

Arch bars and transoms.—Free from rivets, bolts or castings and cut apart. Coupler yokes and engine frames not accepted. All strictly wrought iron.

Miscellaneous flats.—From 3 to 8 inches wide, ½ inch to 1 inch thick and 12 inches or longer. Must be flat, clean and strictly wrought iron.

Busheling Scrap.—All strictly wrought iron 8 inches or less in length and width, includes rivets, nuts, bolts, plate punchings and clippings, cut pipe, scrap chain, and bar croppings. No tank or plate scrap or punchings under 10 gage accepted.
scrap or punchings under 10 gage accepted.

No. 1 Borings.—Car wheel borings or equivalent. Strictly cast iron and large sized.

No. 2 Borings.—Clean and free from other metals, dirt or lumps, and strictly cast iron.

Mixed Borings and Turnings.—Clean and free from other metals, lumps or dirt.

No. 1 Heavy Melting Steel.—Must be of charging box size not over 7 feet long or 18 inches wide and not less than ¼ inch thick. Minimum weight 10 pounds, maximum 300. Includes railroad steel and heavy steel crops from rails, blooms, plates, billets, structural shapes, rods, bars, shearings from steel plates, steel rails, and other similar

material without needle or skeleton scrap. Will not accept agricultural shapes, boiler tubes, cast iron, grate bars, sheet or light stock or curly pieces. Must be clean and free from dirt and excessive rust. Must be loaded separate from other grades.

Shoveling Steel.—Heavy stock including spikes, nuts, bolts, boiler and bridge punchings and clippings, and small crop ends over ¼ inch in thickness and not over 12 inches wide. No light or tangled material or skeleton scrap accepted. Must be loaded from separate cars.

Bundled Steel Scrap.—Strictly new side and end shearings and clippings, bundled with wire to permit handling with a magnet. Not over 125 pounds in weight and charging box size. Stamping or galvanized scrap and rusty scrap will not be accepted.

Compressed Scrap.—Clean steel scrap, including steel clippings and shearings, tin mill scrap, stamping scrap, free from rust, paint or protective coatings, compressed in rectangular bundles, weighing not less than 75 pounds a cubic foot.

APPENDIX D

Government Fixed Prices

The first announcement of fixed maximum prices on iron and steel scrap was made Nov. 5, 1917, covering four base grades, as follows:

No. 1 Heavy Melting Steel	$30.00
Cast Iron Borings	20.00
Machine Shop Turnings	20.00
No. 1 Railroad Wrought	35.00

The next announcement issued Dec. 27, 1917, left these prices unchanged but provided definite instructions as to related grades, the basis for which should be found in the above four prices. This was as follows:

No. 1 Heavy Melting Scrap

The maximum price of $30 per gross ton f. o. b. consumer's works shall apply to all grades of iron or steel scrap to be melted, which normally sold at or under the price of No. 1 heavy melting steel scrap, including malleable cast scrap of all kinds, and cast iron scrap of all kinds, including iron car wheels.

A special charge of not to exceed $3 per gross ton may be paid for cutting heavy melting scrap to sizes 18 inches and under in length.

Steel rails 56 pounds per yard and heavier, 5 feet and over in length, suitable for rerolling purposes, may be purchased at a differential of not more than $3, over the base price of heavy melting steel scrap, provided pay a differential of not to exceed $3 over the base price of heavy melting scrap for low phosphorus material not guaranteed as to analysis.

Parties operating mills, rerolling old locomotive tires, axles, arch bars, transoms, shafting, or similar rerolling material, shall not pay more than $47.50 per gross ton, (the base price of 4 x 4 rerolling billets), for such material delivered at their works.

No. 1 Railroad Wrought Scrap

The maximum price of $35 per gross ton f. o. b. consumer's works applies to all scrap used by iron rolling mills which normally sold at or under the price of No. 1 railroad wrought scrap, and includes yard scrap, track scrap, short wrought, busheling, wrought iron or soft steel pipe and similar material normally used by bar iron manufacturers.

The term "busheling" scrap used in this ruling means scrap suitable for busheling furnaces.

SCRAP METALS

Cast Iron. Cast Iron Borings and Machine Shop Turnings

The maximum price of $20 per gross ton f. o. b. consumer's works applies only to turnings and borings used for remanufacture into iron or steel products.

Parties operating chemical plants or plants for purposes other than the remanufacture into iron and steel products may pay a differential of not to exceed $5 above the base price.

Parties employing recognized scrap dealers or brokers to purchase scrap for them may pay such dealer or broker a commission for such service, not to exceed 3½ per cent of the actual delivered price of the materials so purchased.

The third step in regulation was made Feb. 1, 1918, when the following full schedule of prices and grades was promulgated.

No. 1.—No. 1 Heavy Melting Steel

Base Maximum, $30.

No scrap to be used for remelting into steel shall be dealt in at a price in excess of the maximum base. This shall include all steel, wrought iron, cast iron car wheels, malleable scrap or other grades to be melted in basic open-hearth furnaces (except as noted in clauses 2, 3 and 4).

No. 2.—Low Phosphorus Steel Scrap

(a) To be used only in plants operating acid open-hearth furnaces, crucibles or electric furnaces. This grade, which shall consist of billet, bloom, bar and plate crop ends, axle butts and new mill plate shearings, ¼ inch thick and heavier, no piece to weigh less than 10 pounds, all in charging box shape and which will analyze 0.04 and under in both phosphorus and sulphur, may be dealt in at a differential of not exceeding $10 a ton over the base price of heavy melting steel. Maximum $40.

(b) All other grades of low phosphorus steel scrap to be used in such plants, which will analyze 0.04 and under in both phosphorus and sulphur, may be dealt in at a differential of not exceeding $7.50 a ton above the base price of heavy melting steel. Maximum $37.50.

(c) Special steel, for use in such plants, but which will not analyze under 0.04 in phosphorus and sulphur, may be dealt in at a differential of not exceeding $5 a ton above the base price of heavy melting steel. Such special steel shall include steel knuckles and couplers, rolled steel wheels, railway steel springs, carbon tool steel and similar material in quality and character, suitable for mills of this kind. Maximum, $35.

Note.—Material under this classification may not be dealt in for use by basic open-hearth plants using charging boxes at a price in excess of the maximum allowed for melting steel ($30).

No. 3.—Steel Rails, structural steel or similar scrap which has been especially sheared to short lengths for use in cupolas, hand charging

furnaces or for rerolling purposes may be dealt in at a differential of not exceeding $5 above the base price of heavy melting steel. Maximum, $35.

Note.—Material under this classification may not be dealt in for use by basic open hearth plants using charging boxes at a price in excess of the maximum allowed for heavy melting steel ($30).

No. 4.—Standard section old steel T-rails, free from frog, guard and switch rails, 56 pounds a yard and heavier, 5 feet and over in length, suitable for and to be used only for rerolling purposes, may be dealt in at a differential of not exceeding $5 a gross ton over the price of heavy melting steel. Maximum, $35.

No. 5.—Nickel Steel

Nickel steel scrap, excluding turnings, and containing not over one-half of 1 per cent of chrome, may be dealt in at the maximum price of heavy melting steel plus a differential of not exceeding $4 a ton per unit on the nickel content.

No. 6.—No. 1 Railroad Wrought

Maximum, $35:

(a) No. 1 railroad wrought scrap may be dealt in at a price of not exceeding $35 a gross ton.

(b) When wrought scrap is especially sheared or prepared for piling or fagoting purposes to lengths of not under 10 inches or over 24 inches, it may be dealt in at a differential of not exceeding $5 a ton over the base price of No. 1 railroad wrought, but this may not include short wrought or other material which has not been especially prepared. Maximum, $40.

(c) Wrought iron railroad angle or splice bars, iron or steel shafting, suitable for rerolling, old iron rails, iron boiler plate cut apart in sheets and rings, wrought iron bridge scrap cut apart and similar wrought iron suitable for making sides and bottoms for box piling, may be dealt in at a differential of not exceeding $5 over the base price of No. 1 railroad wrought. Maximum, $40.

(d) No. 1 yard wrought, railroad track scrap and short wrought, also wrought iron and steel pipe, when 1 inch and over in diameter, 2 feet and over in length, free from dirty, painted, enameled or coiled and bent material, may be dealt in at a maximum of $1 a ton under the base price of No. 1 railroad wrought. Maximum, $34.

(e) The commodity known in the trade as No. 1 busheling scrap, when suitable for and to be used only by mills manufacturing bar iron, may be dealt in at a maximum of $3 a ton under the base price of No. 1 railroad wrought. Maximum, $32.

(f) Ungraded wrought iron and steel pipe and tubes, steel boiler plate cut apart in sheets and rings, country wrought and soft steel mixed,

may be dealt in at a maximum of $5 under the base price of No. 1 railroad wrought scrap. Maximum, $30.

No. 7. Iron and steel railway axles, arch bars and transoms, old locomotive tires smooth inside and sheet bar crop ends, when suitable for and to be used only for rerolling purposes, may be dealt in at a differential of $12.50 a ton over the base price of No. 1 railroad wrought. Maximum, $47.50.

No. 8.—Cast Iron Scrap

(a) All cast iron scrap, whether broken or unbroken, including unbroken cast iron car wheels, may be dealt in at a maximum price not exceeding that of heavy melting steel, except as noted in clause b. Maximum, $30.

(b) Cast iron scrap in cupola shape, in pieces not exceeding 150 pounds, including broken cast iron car wheels, when suitable for and to be used only in cupolas or in puddling furnaces, may be dealt in at a differential of not exceeding $5 a ton over the maximum price of heavy melting steel. Maximum, $35.

(c) Malleable scrap of all kinds may be dealt in at not exceeding the maximum price of heavy melting steel. (Exception as noted in clause d.) Maximum, $30.

(d) Malleable scrap in cupola shape, in pieces not over 150 pounds, when suitable for and to be used only in malleable works, may be dealt in at a differential of not exceeding $5 a ton over the maximum price of heavy melting steel. Maximum, $35.

Note.—Cast iron scrap or malleable scrap of any description may not be dealt in for use by basic open hearth furnaces at a price in excess of the maximum allowed for heavy melting steel ($30).

No. 9.—Machine Shop Turnings

Maximum, $20.

(a) The term "machine shop turnings" shall apply to all grades of iron or steel turnings except as noted in clauses b and c.

(b) Heavy axle and forge turnings, or their equivalent, may be dealt in at a price of not exceeding $5 a ton over the maximum price of machine shop turnings, Maximum, $25.

(c) Nickel steel turnings containing not over one-half of 1 per cent of chrome may be dealt in at a price of not exceeding $5 a ton over the base price of machine shop turnings, plus a differential of not exceeding $4 a ton per unit on the nickel content.

No. 10.—Cast Iron Borings

Maximum, $20:

This classification shall cover all grades of cast iron borings (except for the special purposes indicated in clause 3).

APPENDIX D

(a) Cast iron borings and steel turnings, when suitable for and to be used only by chemical plants or plants operating for purposes other than the remanufacture into iron or steel products, may be dealt in at a differential of not exceeding $5 above the base price. Maximum, $25.

The above prices are the maximum which may be paid; buyers and sellers may contract at any price below the figures named.

All the above prices and differentials are per gross ton of 2240 pounds, and in all cases include all freight and charges delivered f. o. b. cars at the consuming mill. For further information communicate with W. Vernon Phillips, chairman, subcommittee on scrap iron and steel, American Iron and Steel institute, Pennsylvania building, Philadelphia.

This cleared the situation and evidently this classification is intended to be continued as a basis, with succeeding changes being reductions or advances on this relative scale. On March 26, 1918, the President proclaimed a reduction of $1 per ton on all items in the above list, a horizontal cut of all grades. These prices were to continue until June 30, when further changes might be made if deemed necessary.

Under date of May 21, 1918, the iron and steel products committee of the American Iron and Steel institute approved rulings of the subcommittee on scrap iron and steel in the following statement accompanying similar action in other products:

The committee approves of and announces rulings of the subcommittee on scrap iron and steel as follows:

Low phosphorus steel scrap may only be dealt in under Schedule 2 (a) when it consists of material specifically named therein.

Shell steel scrap, ship-plate shearings and all other low phosphorus scrap, 0.04 and under in phosphorus and sulphur, must be sold under schedule 2 (b), maximum $36.50.

Schedule 2 (c) may not be abused by the shipment of melting steel scrap to an acid or electric furnace. It shall consist of only low-phosphorus material which will not analyze 0.04 and under in phosphorus and sulphur and must be of a character similar to the material specified therein.

Low phosphorus turnings, including shell steel turnings, may not be dealt in at any price in excess of that announced under Schedule 9.

Shell steel turnings, may only be sold under Schedule 9 (b), maximum $24, when the heavy cuts have been separated to conform with that schedule.

No charge for shearing or otherwise preparing scrap may be added to any of the differentials announced.

APPENDIX E

Net and Gross Ton Equivalents

The following table shows the equivalents of net and gross tons by quarter dollars from $1 to $50.75, as commonly used in the scrap industry.

In using this table the price to be converted is found in the central column and the equivalent is found in the columns at either side headed "Gross" or "Net".

GROSS		NET	GROSS		NET	GROSS		NET	GROSS		NET
$1.12	$1.00	$0.89	$15.12	$13.50	$12.05	$29.12	$26.00	$23.21	$43.12	$38.50	$34.38
1.40	1.25	1.12	15.40	13.75	12.28	29.40	26.25	23.44	43.40	38.75	34.60
1.68	1.50	1.34	15.68	14.00	12.50	29.68	26.50	23.66	43.68	39.00	34.82
1.96	1.75	1.56	15.96	14.25	12.72	29.96	26.75	23.88	43.96	39.25	35.04
2.24	2.00	1.79	16.24	14.50	12.95	30.24	27.00	24.11	44.24	39.50	35.27
2.52	2.25	2.01	16.52	14.75	13.17	30.52	27.25	24.33	44.52	39.75	35.49
2.80	2.50	2.23	16.80	15.00	13.39	30.80	27.50	24.55	44.80	40.00	35.71
3.08	2.75	2.46	17.08	15.25	13.62	31.08	27.75	24.78	45.08	40.25	35.94
3.36	3.00	2.68	17.36	15.50	13.84	31.36	28.00	25.00	45.36	40.50	36.16
3.64	3.25	2.90	17.64	15.75	14.06	31.64	28.25	25.22	45.64	40.75	36.38
3.92	3.50	3.13	17.92	16.00	14.29	31.92	28.50	25.45	45.92	41.00	36.61
4.20	3.75	3.35	18.20	16.25	14.51	32.20	28.75	25.67	46.20	41.25	36.83
4.48	4.00	3.57	18.48	16.50	14.73	32.48	29.00	25.89	46.48	41.50	37.05
4.76	4.25	3.79	18.76	16.75	14.96	32.76	29.25	26.12	46.76	41.75	37.28
5.04	4.50	4.02	19.04	17.00	15.18	33.04	29.50	26.34	47.04	42.00	37.50
5.32	4.75	4.24	19.32	17.25	15.40	33.32	29.75	26.56	47.32	42.25	37.72
5.60	5.00	4.46	19.60	17.50	15.63	33.60	30.00	26.79	47.60	42.50	37.95
5.88	5.25	4.69	19.88	17.75	15.85	33.88	30.25	27.01	47.88	42.75	38.17
6.16	5.50	4.91	20.16	18.00	16.07	34.16	30.50	27.23	48.16	43.00	38.39
6.44	5.75	5.13	20.44	18.25	16.29	34.44	30.75	27.46	48.44	43.25	38.62
6.72	6.00	5.36	20.72	18.50	16.52	34.72	31.00	27.68	48.72	43.50	38.84
7.00	6.25	5.58	21.00	18.75	16.74	35.00	31.25	27.90	49.00	43.75	39.06
7.28	6.50	5.80	21.28	19.00	16.96	35.28	31.50	28.13	49.28	44.00	39.29
7.56	6.75	6.03	21.56	19.25	17.19	35.56	31.75	28.35	49.56	44.25	39.51
7.84	7.00	6.25	21.84	19.50	17.41	35.84	32.00	28.57	49.84	44.50	39.73
8.12	7.25	6.47	22.12	19.75	17.63	36.12	32.25	28.79	50.12	44.75	39.96
8.40	7.50	6.70	22.40	20.00	17.86	36.40	32.50	29.02	50.40	45.00	40.18
8.68	7.75	6.92	22.68	20.25	18.08	36.68	32.75	29.24	50.68	45.25	40.40
8.96	8.00	7.14	22.96	20.50	18.30	36.96	33.00	29.46	50.96	45.50	40.63
9.24	8.25	7.37	23.24	20.75	18.53	37.24	33.25	29.69	51.24	45.75	40.85
9.52	8.50	7.59	23.52	21.00	18.75	37.52	33.50	29.91	51.52	46.00	41.07
9.80	8.75	7.81	23.80	21.25	18.97	37.80	33.75	30.13	51.80	46.25	41.29
10.08	9.00	8.04	24.08	21.50	19.20	38.08	34.00	30.36	52.08	46.50	41.52
10.36	9.25	8.26	24.36	21.75	19.42	38.36	34.25	30.58	52.36	46.75	41.74
10.64	9.50	8.48	24.64	22.00	19.64	38.64	34.50	30.80	52.64	47.00	41.96
10.92	9.75	8.71	24.92	22.25	19.87	38.92	34.75	31.03	52.92	47.25	42.19
11.20	10.00	8.93	25.20	22.50	20.09	39.20	35.00	31.25	53.20	47.50	42.41
11.48	10.25	9.15	25.48	22.75	20.31	39.48	35.25	31.47	53.48	47.75	42.63
11.76	10.50	9.38	25.76	23.00	20.54	39.76	35.50	31.70	53.76	48.00	42.86
12.04	10.75	9.60	26.04	23.25	20.76	40.04	35.75	31.92	54.04	48.25	43.08
12.32	11.00	9.82	26.32	23.50	20.98	40.32	36.00	32.14	54.32	48.50	43.30
12.60	11.25	10.04	26.60	23.75	21.21	40.60	36.25	32.37	54.60	48.75	43.53
12.88	11.50	10.27	26.88	24.00	21.43	40.88	36.50	32.59	54.88	49.00	43.75
13.16	11.75	10.49	27.16	24.25	21.65	41.16	36.75	32.81	55.16	49.25	43.97
13.44	12.00	10.71	27.44	24.50	21.88	41.44	37.00	33.04	55.44	49.50	44.20
13.72	12.25	10.94	27.72	24.75	22.10	41.72	37.25	33.26	55.72	49.75	44.42
14.00	12.50	11.16	28.00	25.00	22.32	42.00	37.50	33.48	56.00	50.00	44.64
14.28	12.75	11.38	28.28	25.25	22.54	42.28	37.75	33.71	56.28	50.25	44.87
14.56	13.00	11.61	28.56	25.50	22.77	42.56	38.00	33.93	56.56	50.50	45.09
14.84	13.25	11.83	28.84	25.75	22.99	42.84	38.25	34.15	56.84	50.75	45.31

The Old Metals

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CHAPTER I

Old Metals Rise to New Dignity

While nearly all kinds of metals leaped in price to twice or more the height of their old quotations in the past two years, and some of them then have slid downward, and the production of all has been boosted, the old metals market and secondary metal production have kept pace and themselves turned some flipflops. Many old metals now sell at prices that would have sounded fabulous for virgin metals in 1913, or even as recently as early in 1917. Block tin pipe in the latter period, for instance, was bought by dealers for about 35 cents a pound, and the virgin tin market was only a few cents higher than that figure then. This spring (1918) block tin pipe has been quoted as high as $1, and the active business for some time has been around 85c to 90c.

No accurate statistics on the old metals trade of recent date are available, while on the production of secondary metals the latest figures given out by the United States Geological Survey are for 1916. These figures are shown in an accompanying table. From the course of the market in the past year and a half it is known that the recovery of some of these products has grown still larger.

The size of the trade in old metals in tonnage, as well as in value, is astonishing, and the rapid growth, stimulated by war conditions, is nearly as spectacular as the

recent history of the spelter market. In 1915 secondary metals recovered amounted to about 350,000 short tons, valued at $114,300,000; and in the following year 600,000 tons, valued at $265,377,000.

These figures made the secondary metals business in 1916 as large in volume as lead or spelter in 1917, and in value more than equal to the two combined. The tonnage is as large as the entire output of copper from domestic ore several years ago, or almost as large as

CHANGES IN OLD METALS PRICES IN NEW YORK

	Jan., 1917	May, 1917	Sept., 1917	May, 1918
Heavy copper	25.00	28.00	24.00	22.25
Red composition	20.00	24.50	22.00	22.50
Heavy brass	15.00	17.50	15.25	14.5025
Heavy lead	6.25	8.75	7.00	6.35
Zinc	6.75	7.15	6.25	6.00
Block tin	35.00	52.00	52.00	90.00
Sheet alum	35.00	42.50	28.50	22.50

even the entire primary refined copper production from domestic and imported ore as recently as 1909.

Copper and brass, of course, form the great bulk of the business. Secondary copper, including that contained in brass, on the basis of a 70 per cent alloy, aggregated 273,000,000 pounds in 1913. This was the high-water mark until recently. The following year the amount declined to 255,700,000, due to war conditions. In these two years old heavy copper, crucibled, fluctuated mostly between 12c and 16c, while now in New York the price has been around 22c and considered weak. A glance at the accompanying table will give an

idea of what has happened to copper and brass prices in the past year and a half. Of the secondary copper, more of it is in the form of remelted brass than in ingot

SECONDARY METALS IN 1916

	Short Tons	Value
Secondary copper, including that in alloys other than brass	140,000	$ 68,880,000
Remelted brass	300,000	127,440,000
Secondary lead	56,700—	13,289,000
Recovered in alloys	39,600—	
Secondary spelter	50,700—	14,284,400
Recovered zinc, alloys other than brass	2,600—	
Secondary tin	7,600—	15,131,040
Recovered in alloys	9,800—	
Secondary antimony	80—	2,270,016
Recovered in alloys	4,400—	
Secondary aluminum	12,900—	23,430,200
Recovered in alloys	6,400—	
Secondary nickel	16—	652,000
Recovered in alloys	800—	

Note.—Nickel by International Nickel Co., and all nickel from ferrous alloys not included.

or alloys other than brass, as shown in the table. In 1916 (calculated), from the figures of the table, secondary copper amounted to about 700,000,000 pounds, or about a third as large in volume as the new metal produced from domestic ores.

Tin is one of the fireworks members of the old metals trade. For a number of years block tin pipe could be bought around 30c and less. Tin plate, as well as alloys with tin, are such difficult propositions to handle at a profit in recovery that most of the metal is reclaimed in alloy rather than in the form of pig tin, despite present

demand for the latter. All kinds of old metals containing tin have been in demand and have climbed in price.

Aluminum is another metal of wide fluctuations. Several years ago it was quoted around 12c as old sheets.

CHAPTER II

Heavy Copper Good in Making Alloys

The specifications for scrap metals adopted by the National Association of Waste Material Dealers define "heavy copper" as copper not less than $\frac{1}{16}$-inch thick, and may include trolley wire, heavy field wire, heavy armature wire, that is not tangled, and also new copper clippings and punchings, untinned and clean, and copper segments that are clean.

Heavy copper, while requiring a little more careful handling in melting than ingot copper, to avoid undue oxidation, upon receiving this attention is fully equal to ingot for the purpose of making alloys of brass, bronze and other metals, such as babbitts containing percentages of copper. It is not suitable for making electrical copper castings where conductivity is a requirement, because there is a possibility of its containing some alloying element, such as silicon, phosphorus, tin or zinc; and for the purposes of electrical conductors high purity is essential to high conductivity.

It is possible to make high conductivity castings from heavy copper scrap by careful selection, and this is frequently done. But such material, when used indiscriminately, cannot be relied upon for this purpose; but for the purpose of making such alloys as bronze, 88-10-2, and kindred alloys, and for composition 85, three fives, and for yellow brass, heavy copper makes excellent material.

In melting trolley wire in crucibles the best results are obtained when it is cut into lengths of about 18 inches for melting in a No. 40 to a No. 70 pot. For larger crucibles the wire can be cut to greater lengths, as the crucible is deeper. A good way to gauge the length of the wire for any size crucible is to make it long enough for about one-third to extend above the top of the crucible when the wire is placed upright therein. When melting trolley wire a "deepener" should always be used on the crucible. This consists of the bilge cut from a worn-out crucible, usually, but they may be purchased new to fit any size crucible. The deepener protects the lengths of wire protruding out of the crucible from the furnace gases and prevents them melting off and falling outside the crucible.

Small blocks of hard wood should be placed in the deepener on top of the wire to furnish a charcoal covering for the copper as it melts. The gases from the burning wood act as a protection to the heated copper.

Handled in this manner trolley wire usually can be packed in the crucible so that the entire charge of copper can be contained therein cold. When it is not possible to get in all of the trolley wire at one time, and additions have to be made when part has first melted, it is well to adopt the precaution of warming the residue of the wire to drive off moisture that otherwise would produce little explosions when the cold wire is introduced into the bath of the melted copper. These explosions cause loss of copper, as some of the molten charge is ejected. The loss can be kept down by a thick layer of charcoal, and by warming the wire. The latter should not be made so

hot that it cannot be easily handled by gloved hands, otherwise tongs have to be used, and much time is lost thereby.

After the wire is melted the additions of tin, zinc and lead are made in the usual manner.

Heavy copper field wire and heavy armature wire should be annealed and compressed, or bundled, when in coils. In melting it is treated much the same as trolley wire, and the same precautions are necessary; but when in coils it is not always possible to use a deepener, as the part of the coil protruding above the top of the crucible is often too bulky. This makes it necessary to watch carefully the copper as it softens to avoid loss of wire in the furnace. When field and armature wire is cut into short lengths it is easier to charge, both into the crucible and the open-flame furnace.

Copper clippings consisting of corners and other angular pieces are more difficult material to handle than wire, unless annealed and compressed into bundles, because, owing to their awkward shape, much space is left between pieces and the crucible. In melting this material constant attention is necessary in order that it may be punched down in the crucible as soon as it softens, both to prevent excessive oxidation and to enable more metal to be charged. The time factor is extended in melting this material. Unless very heavy it should not be considered a good melting proposition for the foundry when in loose form.

Because of the surface exposed it also will oxidize more readily than the other forms of heavy copper, making the addition of deoxidizers advisable. An addi-

tion of 0.25 per cent of 15 per cent phosphor copper can be recommended if all danger of porosity of castings is to be avoided. In this connection the use of low sulphur fuels is important.

Copper punchings usually are circular in shape, some being about the size of a dollar. This material is very desirable, as it packs more closely than ingot, and lends itself in an ideal manner to making weights. Because of their convenience copper punchings are in demand for use in conjunction with ingot copper to facilitate getting exact weights for the mixtures. The copper is usually of good grade, and although the punchings are usually covered with oil the loss from this source is very small and can be ignored so far as concerns the mixtures.

Copper segments also are good raw material for making alloys, from the weight-making and melting viewpoints. The copper is very likely to contain alloy, however, especially silicon, and for this reason is not so suitable for bronze or composition casting as for making yellow brass.

Small percentages of tin, zinc and lead are not particularly harmful to copper when used for alloying, and a little phosphorus is beneficial, but silicon and aluminum are a source of dirty castings. Fortunately, aluminum is far from a success as a deoxidizer for copper, and for this reason cast copper is not likely to contain aluminum, but it frequently contains silicon, and as commutator segments are often cast, and then rolled or pressed, it follows that they fall under the suspicion of containing silicon. This element reacts with any lead present in the alloy to form a lead silicate, which produces dirty

castings. If the source of the commutator bars is known and they are of rolled copper, without any admixture of bars of unknown origin, the material, if free from mica, is excellent for all brass foundry purposes. Mica does no harm, but makes the loss higher.

When first commencing to use a consignment of mixed commutator bars, it is advisable to run off a small trial heat of sand castings of some alloy containing a considerable percentage of lead. If the bars contain silicon enough to hurt the castings will show inclusions of a whitish powdery dross. In such cases the material should be diluted with clean scrap to the point where no further difficulty is experienced from this source.

CHAPTER III

Copper Wire Suited for Electric Castings

Scrap copper wire is classified as No. 1 and No. 2 copper wire. The former should consist of clean, untinned copper wire, not smaller than No. 16 B. & S. wire gauge, and it must be free from burnt wire that is brittle, and from foreign substances. No. 2 copper wire should consist of miscellaneous clean copper wire, such as of necessity must be taken out of the heavy copper and the No. 1 copper wire. It must be free of hair wire and also burnt wire that is brittle.

It will be noted that the No. 1 wire has the advantage over the No. 2 grade in being more carefully selected, as all material below a specified size is rejected. Scrap No. 1, therefore, is more uniform than No. 2 and can be relied upon to give more concordant results, as far as the physical properties of the alloys made therefrom are concerned. The No. 1 is to be preferred for castings in which it is necessary for different heats to match in color.

Scrap copper wire that has seen service in electrical apparatus, that has been deprived of its insulation by burning and afterward compressed to briquettes, is excellent copper, because such wire is usually purer than ingot and has passed a test for electrical conductivity that insures a high degree of purity. Such copper, therefore, can be used for copper castings even when conductivity is essential.

Telephone wire, however, is not suitable for copper castings, but may be used with good results for making alloys. This is due to the fact that much of this wire contains tin, which is added to increase its tensile strength. The tin also decreases the conductivity of the wire. One grade which contains around 1.5 per cent tin has a conductivity of 40 per cent of that of pure copper, and another grade containing approximately 0.5 per cent tin has a conductivity of 60 per cent of that of pure copper.

For making bronze and brass these small percentages of tin do no harm. In fact, they improve the alloy as a general thing, for rarely is the tin content of any alloy so high that an additional 1 per cent will do any harm. In cases where a considerable supply of telephone wire is available for alloying purposes, it would pay to have an analysis made to determine the exact tin content; then in making the alloys the tin could be allowed for, resulting in a considerable economy.

When copper wire is melted for copper castings it will be necessary to add more deoxidizer than is required for ingot copper. Thus, if 0.5 per cent of 10 per cent silicon copper be added to ingot copper it will be advisable to increase this quantity to 0.75 per cent in the case of compressed copper wire, because this material is more oxidized. In making brass or bronze it is also advisable to use consistently a deoxidizer. In the case of bronze and composition, the addition of 0.25 per cent of 15 per cent phosphor copper is advisable. It should be placed in the bottom of the crucible with the cold copper. In making brass, 5 ounces of 30 per cent

manganese copper should be added, and this also should be placed in the bottom of the crucible with the cold copper.

A hot furnace should be used for melting scrap copper wire, so that it can be reduced to the condition of a liquid as rapidly as possible, thereby giving little time for surface oxidation of the wire.

CHAPTER IV

Light Copper Better for Furnace Than Foundry

Light copper should consist of the bottoms of kettles, bath tub linings, hair wire, burnt copper wire which is brittle, roofing copper, and similar copper, free of visible iron, brass, lead and solder connections, old electrotype shells and free of excessive paint, tar and scale.

This material is more fitted for the refining furnace than the brass foundry, but it is extensively used for certain classes of castings, such as car journal brasses and castings where the greatest requirement is that they shall be free from rusting. Copper bottoms generally contain iron in the form of wire, enclosed by the beaded sections of the scrap. The consequence is that when it is melted the metal is always rich in iron, which hardens alloy and injuriously affects its casting and machining qualities. This metal can only be used for castings subjected to little finish, or that are ground to a finish because considerable of the iron exists in the form of nodules of extreme hardness.

Copper bottoms have to be cabbaged before they can be economically melted, and frequently it is necessary to open the beads and remove some of the iron wire. The bottoms frequently carry considerable carbon burnt on, and the loss from this source and the iron is always high. Bath tub linings are similar to bottoms, but less likely to contain iron, but they are apt to be painted.

Hair wire is wire of extreme thinness and because of this physical condition it exposes such a large surface to oxidation that it is very undesirable material to melt for castings. It is improved in this respect by hammering or otherwise compressing into small bulk. Burnt copper wire also is badly oxidized, and when it is brittle it contains sulphur. The combination of sulphur and oxygen causes blowholes in copper or brass made from such copper, because sulphur and oxygen react with each other to form gas, sulphur dioxide, which is retained by the copper sufficiently to form porous castings.

When such material as copper bottoms, hair wire and burnt brittle wire is melted together, the bath contains, in addition to the copper and the impurities it might have contained, sulphur, oxygen and iron. The latter will take up oxygen and become ferrous oxide, and if sand be used as a flux the ferrous oxide will unite therewith to form ferrous silicate, which is very fusible. If there were enough oxygen present to convert all the iron to oxide, it would be largely eliminated in this way; but the sulphur remains with the copper, and while it is removed by oxygen, this is a tedious operation, so that in simple melting the molten metal contains both oxygen and sulphur, which reacts constantly to form sulphur dioxide.

Consequently, since the gas is formed as the metal cools, the castings are aerated instead of being sound. It would be better, therefore, not to mix the burned brittle wire with the other material, but to melt it alone and keep it molten for a considerable period in order to

remove the greater part of the sulphur by allowing the copper to oxidize in the furnace. The resulting oxidized copper should be ingoted and afterward remelted over calcium carbide packed in the bottom of the crucible. Usually light copper is added to scrap brass, such as yellow brass, to decrease the zinc content; and to the resulting alloy, lead is added until it will carry no more, and the metal is used for common freight car brasses.

CHAPTER V

Electrotype Should be Made Into Casting Copper

The specifications for electrotype plates or shells are to the effect that they must be hand-picked and free from dross. This material, which comprises electrotype, linotype and stereotype shells, consists of the copper veneer stripped from the white metal backing and wood block that forms this useful adjunct of the printing trade.

The electrotype is sold to the scrap metal dealer, who burns off the wood block and metls out the white metals as cleanly as possible. A considerable amount of the white metal is left, however, enough to spoil the material for making castings, although it sometimes finds its way into the market in the shape of ingot metal of very poor quality. The analysis of a sample ingot of this kind showed around 62 per cent copper, 30 per cent lead, 5 per cent antimony and 2 per cent tin. The presence of such a large amount of antimony made the metal brittle and totally unfit for casting purposes.

The proportion of copper in electrotype shells depends upon the care with which the white metal is melted or sweated out of them, and will run from 42 to 60 per cent. This material is more fitted for smelting into casting copper than for making into alloys, as the antimony and other impurities are certain to cause trouble in making castings, even when the original metal

obtained from melting down the shells has been fattened by the addition of copper and tin.

Linotype metal, stereotype metal and electrotype metal are all made from antimonial lead, which is a by-product in silver refining. The natural alloy is melted, and in refining, the lead-antimony mixture separates from the silver as a dross, and this dross, when treated in a blast furnace, is reduced to a metal containing lead, antimony, arsenic, copper and iron. The arsenic content may be over 5 per cent, and a further refining is necessary to reduce the impurities to the point where they are not harmful for the purposes of a white metal, but they are not reduced enough to allow the metal to be used in quantity for making brass or other copper alloys. Consequently when electrotype shells, which always are associated with a large percentage of this white metal, are used for casting purposes, impurities are introduced into the alloys which may be responsible for much trouble and loss in the production of castings. All such difficulties are avoided by purchasing ingot metals from responsible manufacturers.

CHAPTER VI

Sorting Red Brass Makes Foundry Savings

Composition of red brass shall consist of red brass scrap, valves, machinery bearings and other parts of machinery, including miscellaneous castings made of copper, tin, zinc and (or) lead; no piece to measure more than 12 inches over any one part; to be free of aluminum and manganese; also free from railroad boxes, cocks and faucets, gates, pot pieces, ingots and burned brass.

In the utilization of secondary metals red brass scrap is high grade material; but to use it to the best advantage it should be picked over by someone familiar with the alloys most generally used in castings. Thus the valves should be segregated, as it is pretty certain they contain nothing that would be injurious, such as aluminum. While the composition of the valves may vary to a considerable extent, they usually can be relied upon to produce a good red metal for general castings. They can be used also in the place of tin for hardening yellow brass.

In melting valves they should never be taken from the bin and added to a bath of molten metal, as disastrous explosions have followed this practice. This explosive action results because they may be damp inside. If all the valves it is desired to melt in a heat cannot be added with the first charge, and additions must be made, they should be superheated by being placed in a sawed-

off old crucible, which is placed in the furnace on top of the pot that is melting to heat. When the valves get a dull red they should be removed and thrown upon the floor. They then can be added to molten metal without any danger.

Machinery bearings make good scrap. The undesirable material to be looked for is highly leaded metal and phosphor bronze. Metal with a high lead content can be identified generally by fracture; but phosphor bronze will have to be melted, when it can be identified by its great fluidity. Bearings high in tin can be identified by the fracture, which is close-grained and whitish. Such castings can be used in place of tin for making red brass, especially if each heat consists in part of new metal and part of red brass scrap. A judicious mixing of the high tin scrap will make unnecessary the use of any metallic tin. Even in normal times it is desirable to economize on tin, because of its high cost, and the foundryman who understands his scrap pile has a tremendous advantage over his competitors in this respect, and can undersell them every time.

As a general thing all scrap machinery parts of brass contain good metal. It is always advisable, however, to break off corners and examine the fractures. A reddish speckled fracture shows excessive oxidation, and the wise melter takes his precautions against porosity of product by using care in melting and adding a deoxidizer. Miscellaneous castings of red brass are not always what they seem in these days of aluminum and manganese bronze, as it is difficult to identify these alloys when mixed with other scrap, no matter how

desirous the dealer may be of removing them. They often can be identified, however, by means of an emery wheel, by grinding them so hard as to heat the metal. Manganese bronze will show greenish-yellow streaks, while aluminum bronze will heat greatly, burr over at the sides and abrade slowly. Large castings that have to be broken up are easily identified, as when red hot they are tough and cannot be broken.

When all the better grade of metal has been removed from the scrap brass, the residue of doubtful composition should be used for the less important castings.

Red Brass Turnings

Red brass turnings, No. 1, or, as they are sometimes termed, No. 1 composition turnings, must be free from aluminum, manganese, plastic and yellow brass turnings; not to contain over 2 per cent iron, to be free from grindings and other foreign material, especially babbitt, and free from adulterations made to resemble metal. Turnings not according to this specification are subject to sample.

The great difficulty with turnings is that in spite of all precautions they are very liable to contain turnings of metals that have aluminum as an ingredient, and this is especially the case now that aluminum bronze is so extensively employed, as the latter is used for many of the same purposes for which phosphor bronze formerly was employed exclusively.

Manufacturers of worm gearing for automobile use are large producers of phosphor bronze turnings, and aim to keep them free from other metals. But it is not

uncommon to encounter trouble from aluminum in remelting these turnings. Every effort should be exerted to keep red metals free from contamination by aluminum.

Iron exists in red brass chips in the free condition and can be removed almost entirely by passing them twice through any good magnet machine, a precaution that should never be neglected before melting turnings. When free from aluminum and iron red brass turnings are not difficult material to handle in the brass foundry. In melting in crucibles the pot should be filled and space left for about an inch of fine charcoal, then the fire should be allowed to burn strongly so the turnings can be melted rapidly. When they are liquid, if properly melted, no pasty material will be floating on top of the metal, but it will be clear under its cover of charcoal.

More turnings now are charged, but it is advisable to charge no more than the molten metal will take up without entirely solidifying. The second charge is melted rapidly and is brought to a high temperature. The third charge of turnings will be larger than the first, and as the bath of metal increases the amount of cold turnings that can be charged at a time will increase progressively, so that after the first start the operation will go with rapidity.

Turnings melted in this manner will oxidize the minimum amount and the resulting metal will be all that can be desired, especially if the turnings first be ingoted and the ingots remelted. This, however, is not always necessary. In the case of one shipment of red brass turnings it was found the composition was as fol-

lows, by analysis: Copper, 85.65 per cent; tin, 7.45 per cent; lead, 2.40 per cent; iron, 0.15 per cent; aluminum, 0.22 per cent; phosphorus, 0.32 per cent, and zinc 3.81 per cent. The aluminum was eliminated by mixing with the turnings before melting 5 per cent of copper oxide. The turnings and copper oxide were then melted in the usual manner and the result was phosphor bronze without any trace of aluminum.

CHAPTER VII

Yellow Brass Clippings and Turnings Good

New yellow brass clippings shall consist of the cuttings of new sheet brass, to be absolutely clean and free from any foreign substance. This material is sometimes known as skeleton brass, and it consists of brass sheets from which small articles have been punched, and corners and clippings of sheet material from various operations that use sheet brass.

As it is mechanically impossible to punch the articles so as to use up all of the sheet, a residue always remains, the amount of which depends upon the nature of the articles punched. Also, when circular forms are cut from sheet brass, corners and thin strips always are left. Sometimes as much as half of the original sheet is left as clippings. It was at one time customary to roll the skeleton brass; but the best way of preparing such material for melting is to form it into rectangular briquettes of about 25 pounds each, which now is being done largely. In the loose condition clippings make disagreeable material to use in the brass foundry and to melt in the ordinary type of brass melting furnace, as only a little can be charged at a time and much is unavoidably lost by falling into the fires. The surface exposed to oxidation is enormous. Therefore, such material should never be used unless pressed into briquettes.

In the condition of briquettes, yellow brass clippings make a desirable raw material for foundry use. It is a

fact well established that only the best copper and spelter will produce brass that will roll into sheets; therefore this metal is of the best grade, as proved by the fact of its being sheeted. It is not always easy to obtain this material, as the rolling mills take back this scrap when made from their own sheets, as they are able to use it to good advantage in making their mixtures, and converting it into new sheet again. In the brass foundry, brass clippings can be used economically in many ways, as, for instance, in making red brass and bronze as a zinc carrier, and also for making manganese bronze, and other high-grade yellow alloys. Before using the clippings for the latter purpose and for bronze with which difficult specifications must be met it would be well to ascertain if they be free from lead. The best way to detrmine this point, of course, is to run an analysis for lead; but if this be not convenient a fair estimate can be made by melting an ingot from the stock and drilling it. If the stock be leaded the chips will break and the ingot will dry fairly easily; but if the chips are curly the stock contains no lead.

The favorite mixture for sheet brass is the 2 to 1 mixture; that is, 2 parts of copper to 1 part of zinc, approximately 66 per cent copper and 34 per cent zinc. As high as 40 per cent zinc and 60 per cent copper can be rolled; but it is so hard that it is rarely used for small articles in this country, although it was more extensively used in the brass articles which formerly were obtained from Germany. The average composition of clippings can be figured as from 63 to 70 per cent copper and 30 to 37 per cent of zinc; and unless inten-

tionally leaded, little of this metal will be present. If leaded it will not exceed 2.5 per cent, as this amount is practically the limit of successful rolling.

Brass clippings that are briquetted should be a preferred commodity in brass foundries, as they are easily handled in melting, and, used to alloy with red brass and bronze as zinc carriers, they produce an alloy that is better, usually, than could be obtained by using ordinary zinc therein.

No. 1 yellow brass turnings shall consist of strictly rod turnings, free from aluminum, manganese, composition and tobin turnings. They shall not contain over 3 per cent of iron, oil, or other moisture, and be free from grindings and babbitts. To avoid dispute, they shall be sold subject to sample.

Brass rods are used in enormous quantities to supply automatic machines with material from which studs, pins, rivets, screws, knobs, and thousands of other small articles can be fashioned cheaply. This results in a large production of brass chips. Often the weight of the chips exceeds the weight of the articles made from the rod; consequently yellow brass turnings of this description are a standard commodity of the scrap and metal trade. These chips usually are leaded, as the rod from which they are made must machine freely. They will contain from 2 to 2.5 per cent of lead, and it is easy to identify leaded brass chips by their short appearance, as they are finely divided, while the unleaded brass turnings will be in the form of spirals and fibrous shavings.

The composition of screw rod chips is approximately

as follows: Copper, 62 per cent; zinc, 35.75 per cent, and lead 2.25 per cent. Oil is used in cutting brass on the automatic machine and consequently all brass chips are more or less greasy. The amount of oil, however, should not be so great that it runs off and forms pools on the floor where the chips are stored. The oil does not hurt the chips, but as it burns away the percentage of loss is higher in the case of very oily chips. As the chips are bought subject to sample, the condition of oiliness should be taken into consideration.

A considerable amount of screw rod chips at present made come from plants engaged in munition work, and generally contain aluminum. This element causes much trouble in foundry operations; and before purchasing chips of unknown origin, in large quantity, it is always a good idea to purchase a sample of about 500 pounds, which will enable a melt to be made that will be fairly representative of the material. The presence of aluminum is easily detected when the chips are melted, and when its presence is established the proper value of the chips can be determined in a way that will preclude all chance of dispute. As it costs money to eliminate the aluminum, the price should be made accordingly. All chips for foundry purposes should be melted into ingots and the ingots used for catings. In melting chips from aluminized stock, it will be necessary to incorporate an amount of copper oxide that will have to be determined by experiment. The aluminum is thus oxidized out of the turnings, and the ingot produced therefrom is clean and can be used in any place where such chips are consumed. Previous to melting the chips should be put

through a magnet machine to remove the iron, otherwise the ingot brass would fail to machine properly because of the presence of hard nodules of iron.

Clean yellow brass chips can always be used to advantage in brass foundry operations. A method in vogue in some foundries is to use chips in every pot of metal melted. A certain amount of chips is placed in the bottom of the pots, probably about one-fifth of the crucible full, and the ingots are put on top of the chips, the latter forming a cushion for the ingots. The chips melt first and wash off the ends of the ingots. The zinc in the chips acts as a deoxidizer, much of it being volatized and condensing on the surface of the ingots, thus preventing them from being oxidized as they become heated. Where this practice prevails it has been noticed that little difficulty is ever experienced from porosity of the castings. It is always advisable in connection with the use of chips in this manner that a little salt, about a tablespoonful be placed on top of the chips before the copper is charged on top. The chips are not weighed with the heat when used in this manner, as they are measured out with a scoop, which adds a certain amount by weight. The excess zinc in the yellow chips compensates for the loss by volatilization of that in the mixture, and the metal loss is thrown onto the chips.

CHAPTER VIII

Heavy Yellow Brass Good Melting Stock

Heavy yellow brass shall consist of heavy yellow brass castings, rolled brass, rod brass ends, brass screws and tinned nickel-plated brass tubing. They must be free from iron and dirt and must be in pieces not too large for crucibles. No piece is to measure more than 12 inches over any one part. It must also be free from aluminum and manganese mixtures. Condenser tubes shall not be considered as heavy brass.

The percentage of zinc in cast brass may vary considerably, as it has a range from 20 to 40 per cent. Metal having the higher percentage of zinc also is likely to contain aluminum. But this element constitutes an undesirable impurity in yellow brass, as it limits its servicability to castings not subject to pressures. In grading yellow brass those cast parts that show evidences of having been used in situations where they would be subjected to water, gas or steam pressures, may be regarded as safe material to use either in admixture with red brass, as a zinc carrier, or for remelting for yellow brass castings, because it is extremely improbable they could be used successfully for such work if they contained aluminum.

Such cast parts, therefore, can be picked out of the scrap and put aside. Their composition is likely to approximate the following: Copper, 70 per cent; zinc,

25 per cent; lead, 3 per cent, and tin 2 per cent. The miscellaneous unidentified scrap should be picked over so that a representative sample of about 100 pounds can be obtained, and this sample should be melted and poured into ingots.

This test heat will determine how the scrap can be used to the best advantage. If aluminum be present it will show when the metal is fluid by the mirror-like surface imparted thereto, and the ingots, after solidification, will be smooth on top and inclined to a gold color. Such material can be used only in making small castings not exposed to pressures. If the surface of the ingot be corrugated and of a dull khaki color the brass is free from aluminum and can be used accordingly.

Rolled brass and rod brass ends make good yellow brass melting stock. The composition of rolled brass may vary from copper 80 per cent and zinc 20 per cent to copper 64 per cent and zinc 36 per cent. Rod brass ends contain lead, and the composition will approximate copper 62.75 per cent, zinc 35 per cent, lead 2.25 per cent. For the better class of brass castings, the casting qualities of this mixture would be improved by alloying as follows: Copper, 38.25 per cent; rod brass ends, 58 per cent; lead, 1.75 per cent; tin 2 per cent. This will produce an excellent casting alloy of yellow brass that will machine easily.

The composition of brass screws will not vary greatly from the rest of the scrap, and can be used accordingly. Tubing may be considered as being copper 70 per cent, zinc 30 per cent. This nickel plating will do no harm,

as the percentage of nickel in the melted metal is very low, and even if it rose to several per cent it would do no harm in castings, although it might make them a little harder. Yellow brass melts at a comparatively low temperature, and will require a little closer attention than red brass in order not to have excessive zinc losses.

Charcoal or hardwood blocks should be used on the metal to prevent undue oxidation; and in filling additional scrap to some already melted make the addition just after the charge has sunk down and before it gets thoroughly liquid. By so doing, explosions that might cause spattering and loss of metal will be avoided, as the newly charged cold material lies on top of that just liquified and has time to become dry and hot before it sinks below the surface of the bath to become incorporated therewith.

In melting yellow brass the temperature always should be kept below the volatilization point of the zinc until the entire charge is liquified, which is easily accomplished by handling the heat as above. When the heat is all in the crucible, or open-flame furnace, and is just liquified, charcoal or hard wood should be added with a little salt, and the furnace should be urged until the zinc flare is seen. The alloy should then be well stirred and it is ready to pour. In pouring yellow brass every effort should be exerted to keep the pouring heads full of metal, even if brass be spilled upon the floor, as this prevents the ingress of zinc oxide to the mold, which would make the castings streaky and dirty. For small castings pour hot, in which case the surface of the metal will be

just observable when undisturbed, and will flare strongly when broken.

For heavy, chunky castings pour yellow brass cool, so there is no flare at all; and pour strongly into well-vented molds, rammed with sand as dry as possible.

CHAPTER IX

Cocks and Faucets Are Mixed Red and Yellow Brass

Cocks and faucets shall be mixed red and yellow brass, free from gas cocks and beer faucets and at least half red. Both yellow and red brass is used extensively in making such plumbing goods as cocks and faucets; in fact some brass formulas produce a metal that has a decidedly yellow cast after the surface has been machined, which is due to a high percentage of zinc.

As large amounts of scrap are used in making cocks and faucets, it follows that no two faucets will have exactly the same composition. One alloy that is extensively used whenever the price will admit of new metals, consists of copper 83 per cent, lead 4 per cent, zinc 10 per cent, and tin 2 per cent. This mixture is sometimes cheapened by a reduction of the tin content to 2 per cent and an increase of the zinc content by one per cent, but this alloy fails to have the red appearance so desired by some manufacturers.

The analysis of a faucet that had a good red color gave copper 87.55 per cent, lead 4 per cent, tin 3.60 per cent, and zinc 4.85 per cent. The zinc in this is much under 10 per cent and the copper correspondingly higher, and as it is the zinc that yellows the mixture, this last alloy resembles a bronze.

The yellow faucets will contain up to 27 per cent of zinc, with probably 5 per cent of lead and no tin. It is

difficult to tell by the color which scrap consists of real yellow brass and which of a so-called red brass containing around 11 per cent zinc, especially after they reach the status of scrap. Consequently the effect produced by melting a mixture of scrap consisting of half red and half yellow would be to produce a metal having a decidedly yellow tinge when cut.

In making castings from such scrap as old cocks and faucets, if it is essential that the product be red in color when finished, it would be advisable to figure on the necessity of making additions of copper. If we assume that the composition of a red metal faucet with a decidedly bronze appearance approximates copper 87.50 per cent, zinc 5 per cent, lead 4 per cent, and tin 3.5 per and that the scrap pile contains 50 per cent of this scrap, then the other or yellow half contains 25 per cent of scrap consisting of the yellow brass mixture mentioned and 25 per cent of the red brass mixture containing 10 per cent of zinc. Therefore, a melt of this scrap consisting of half good red metal and half of metal having a yellowish cast, would produce an alloy containing approximately, copper 81.50 per cent, zinc 11.75 per cent, lead 4.25 per cent, and tin 2.50 per cent.

This alloy would have a decidedly yellow cast when machined and would look inferior to the faucets made of the red metal. So it would fail to produce the results desired, and in order to make a satisfactory alloy it would be necessary to add copper to the mixture to bring down the content of zinc to around a maximum of 8 per cent. This can be done by taking 70 per cent of the mixed red and yellow scrap and melting it with 27.75 per cent cop-

per, and when the whole is thoroughly liquid, adding 1.75 per cent tin, and 1 per cent lead. The tin could be added in the form of machinery scrap for greater economy, as without the addition of tin the alloy would be too soft after the copper had been incorporated therewith.

Beer faucets, when red, can be assumed to contain a preponderance of lead. This content is the reason they are excluded from scrap cocks and faucets. Gas cocks are yellow brass, high in zinc, as they are made from cheap yellow scrap.

The union of copper with lead used to be termed "pot metal" and contained from 5 to 35 per cent of lead, according to whether it was classed as wet pot metal or dry pot metal. This mixture is not a desirable addition to such scrap as cocks and faucets, and, therefore, is excluded.

CHAPTER X

Light Brass Limited in Uses

Light brass shall consist of light sheet brass, forks and spoons, miscellaneous brass that is too light to be classified as heavy, to be free of any visible iron, gun shells containing paper, or iron loaded lamp bases, and of clock works.

Light brass consists of almost every article for which sheet brass is used, such as old lamps, bird cages, curtain trimmings, door knobs, musical instruments, gas fixtures, brass tubing, match boxes, belt buckles, pins and ornamental brass work of every description. Light brass is full of impurities such as iron and steel, solder and nickel. For casting purposes neither nickel nor solder does any harm, as the lead and tin of the solder are usually in such proportion that the one metal imparts stiffness and the other easy machining qualities.

The iron and steel are undesirable impurities, and greatly limit the use of the material from a casting standpoint. The iron exists in the form of studs, nuts, rivets, pins, wire, springs, washers and brass plated steel articles, the latter being especially difficult to identify when well brass plated, and it would prove too expensive to remove them individually with a magnet, and the pins, rivets, etc., are so firmly imbedded that it would be hopeless to attempt their removal.

The iron, therefore, has to be melted out, in which process no matter what care is used to keep the tempera-

ture of the metal as low as possible, some of the iron will be dissolved, owing to its affinity for the zinc. While some of this iron is chemically combined and does no harm in this condition, a considerable portion, because of its combination with carbon, always separates from the brass as the latter solidifies, and exists as nodules scattered throughout the brass. When this material is used for castings, it is not practical to carry out much machine work because of the danger of striking one or more of these hard pieces.

Light brass, therefore, has to be used for such castings as have little finishings done on them, or that can be finished by grinding. This material is used for cheap car journal brasses, which consist of scrap yellow brass leaded to capacity. But for this purpose as for all other casting purposes it is necessary first to run the brass into ingots and then remelt the ingots for the castings. By this practice the brass gets skimmed twice and this favors the removal of the iron. The loss in melting light brass runs from 15 to 22 per cent, due to the iron, the thinness of the metal and to nonmetallic material concealed in some of the articles. The average composition of the material after being ingoted will be copper 72 per cent, zinc 28 per cent, allowing for loss of spelter and not considering solder and iron.

Light brass is a material entirely unfitted for making brass castings that require machining, and especially for castings finished by automatic tools. When light brass is smelted for its copper contents, as is sometimes the case, all the iron, zinc and other impurities are elimi-

nated in the slag, but this method results in the waste of a large percentage of the material.

For car journal bearings, light brass is melted in large heats into ingots, and the ingots are remelted with scrap copper bottoms and miscellaneous red scrap, and the resulting metal is treated with all the lead that it has been experimentally determined can be held in the metal without dropping to the bottom of the castings.

It will be noted that the specifications for light brass state they shall be free of iron-loaded lamp bases and of clock works. It follows, therefore, that these latter have to be removed from the light brass scrap, and as it would be too costly to pound them up and remove the iron they are allowed to accumulate and are sold for what they are. The iron can be removed from the lamp bases quite easily and the brass part thrown into the light brass, but the clock works are a thing separate unto themselves and have to be accorded special treatment.

Clock works have two outlets: First, as a raw material for copper smelting; and second, as a source for making yellow brass ingots. In the first outlet all the zinc is lost, which will be seen from the composition of the brass, as it is a considerable percentage of the metal. The average composition of clock brass is copper 62.50 per cent, zinc 35.75 per cent, and lead 1.75 per cent. Clock works at one time were used largely in making car journal bearings of the cheap kind. They were run down at a low temperature in crucibles holding 1000 pounds, the metal skimmed of iron and then ingoted, and the ingots melted with a percentage of copper in the

form of old copper bottoms. A comparatively large amount of lead was added.

Clock works, however, make inferior and irony metal because so many of the little screws and pieces of steel springs melt and enter the brass. The best way to utilize them is to take the loss of zinc and recover the copper only. When clock works are used for the copper content thay are assayed to determine their copper value. To accomplish this it is necessary to take a half bushel sample, as nearly representative of the pile of clocks as possible, and by the use of vise, hammer and cold chisel to remove all the steel parts from the clock works. This must be carefully done and the clock works are weighed both before and after the removal of the iron parts. When clean of iron the brass is melted under borax and ingoted and the ingot analyzed for copper. By multiplying the weight of the ingot in grams by the percentage of copper found by analysis, the content of copper in the ingot is found in grams. If this figure is multiplied by 100 and divided by the weight of the brass before being melted, and after the iron has been removed, a figure is obtained that represents the percentage of copper in the clocks. On this figure, which is the copper value, is based the price of the clocks.

CHAPTER XI

Railroad Bearings Not for Red Brass

Railroad bearings shall consist of railroad boxes or car journal bearings; must be old standard used scrap, free from yellow boxes, plastic and similar bearings, also iron backed boxes; and must be free from babbitt as well as from excessive grease and dirt.

The better class of railroad bearings usually consist of an alloy of copper 80 per cent, tin 10 per cent, and lead 10 per cent, and they often are bought subject to the fracture test. In this test a certain number of furnished bearings are taken from each shipment and then are broken midway of their length; the fracture is examined for segregation and oxide spots. Such scrap material is fairly good, but as it is made from all scrap in the first place and may have been remelted several times, it is not to be recommended for general brass foundry purposes.

Even when car brasses are free from yellow boxes they do not make good material for melting into ordinary red brass castings, as a general rule, and for this reason they usually are remelted and again run into brasses. A car brass picked at random from a pile of such scrap should show the following analysis: Copper 89.80 per cent, lead 10.20 per cent, zinc 10.30 per cent, tin 6.90 per cent and antimony 0.80 per cent. An analysis of brass chips or borings from machines boring car brasses was as follows:

Copper 78.50 per cent, lead 7.50 per cent, zinc 8.70 per cent, tin 4.80 per cent and antimony 0.50 per cent.

The high percentage of zinc for a bearing metal will be noted, also the presence of antimony, derived no doubt from scrap brasses used to form the analyzed mixture. These were supposed to be a good grade of scrap. Yellow boxes are made from scrap yellow brass, highly leaded and containing iron, and are much inferior material to the analysis given.

Plastic bearings contain from 25 to 30 per cent of lead, 4 to 5 per cent of tin, and a minimum of 65 per cent copper. Some plastic bronzes contain manganese in place of a part of the tin, and sometimes the manganese is higher than the tin content. One such alloy had only 1.5 per cent of tin. Such material is poor for general brass foundry use and is not to be recommended. In spite of the fact that it should be omitted from this general grade of scrap, it is often difficult to identify this inferior metal, although this can be done easily by the experienced scrap grader because of its high specific gravity.

CHAPTER XII

Block Tin Pipe and Foil Have Good Uses

When block tin pipe is clean and free from lead, it is as good for brass foundry use as new pig tin, and it can be used just as it is without remelting and running into ingots. The same precautions should be observed in adding a section of block tin pipe to molten metal, as is necessary in the case of lead pipe—that is to be sure no liquid or moisture is left in the pipe. Lengths of pipe with both ends battered up must be regarded with suspicion as they are likely to contain liquids. It is best to cut open the pipe before adding it to molten metal.

Block tin pipe is used for conveying distilled and carbonated waters, beer and other liquids that must be free from metallic contamination. But the amount that finds its way into the market is not large, and in many brass foundries this material is never seen. The waste in melting depends upon the quantity of dirt the scrap contains, and this is a thing purchasers must look out for as the price of tin is such that considerable loss may follow if much liquid be present in the pipe.

The loss in melting clean block tin pipe runs from 4 to 5.5 per cent; but in the case of pipe that is dirty, or pipe that contains liquids, the loss will be much higher. For making solder, tin pipe should be run down in a kettle, and if the capacity of the kettle be known, it will be unnecessary to run the metal into pigs. But if it be not known, this may be necessary to get the correct weights

of tin in the alloy, as a rich tin mixture would cost considerably more than the double melting of the scrap.

Tin foil is not pure tin but a mixture of tin and lead, although the specifications adopted by the National Association of Waste Material Dealers state that it shall consist of pure foil free of lead compositions and other foreign ingredients and matter. The composition of tin foil will vary all the way from 97 parts of lead and 3 parts of tin, used for tobacco wrappers, to almost pure tin used on food stuffs. In view of the fact of tin being a semi-precious metal, there is every likelihood that pure tin foil will soon become nonexistent, and will be replaced entirely with aluminum foil, or waxed paper.

Tin foil can be run down into ingots and utilized in making solders or in brass foundry practice it can be used in making red brass mixtures. This material should never be melted alone, however, as the loss would then be enormous. The best way to handle it either for solder or for alloying is first to melt a bath of tin in a babbitt kettle, and then to dissolve the tin foil in the molten metal. The tin used to form the dissolving bath should be accurately weighed so that the amount of the recovery from the foil can be arrived at. It is better to use tin as the dissolving bath, instead of lead, because it can nearly always be figured that the percentage of lead in the foil is greater than that of the tin, and the use of tin for the bath makes it more easy to get a composition of 50 per cent tin and 50 per cent lead, which produces ordinary solder.

The 50-50 composition is a very easy one to work up into an alloy of tin and lead. For wiping solder the lead

must be increased to 2 parts lead to 1 part tin, and for the highest grade of solder the tin is increased to roughly 2 parts tin to 1 part lead. A little antimony usually is added to solder as it gives the ingots a better appearance.

The 50-50 lead-tin composition is also very handy in making red brass mixtures, such as the well-known steam metal, copper 85 per cent, tin 5 per cent, lead 5 per cent and zinc 5 per cent. In this case it is only necessary to use 10 per cent of the 50-50 alloy, and 5 per cent of zinc to 85 per cent copper, to make the alloy, so that, all things considered, in melting tin foil it is advisable to figure on making a 50-50 alloy.

In order to keep down the oxidation it is a good plan to dip the balls of tin foil in oil and let them drain before immersing them in the bath of tin. As the balls of foil may contain water, some caution is required in pushing them below the surface of the bath. In fact, it may be thought advisable to open the balls before melting them. This procedure presents an opportunity to eliminate the aluminum foil, and also stones and other objects which are frequently used as a nucleus on which to roll the foil. In any event the foil should be immersed in the bath of metal as soon as possible, so that it will be quickly incorporated therewith, and when all the foil is melted or the kettle is filled, a little rosin or tallow should be thrown onto the surface of the metal, if the oil used on the foil has not proved sufficient flux. The dross will thus be reduced to dust and can be skimmed off and saved for sale to the refiners.

The best way to convert the remelted metal to 50-50 alloy is to determine its composition by means of the

solder scale, an instrument designed to give the composition of any tin-lead alloy by weighing a small specially produced ingot of the metal. The composition of the bath can thus be ascertained in a few minutes, and tin or lead as required may be added until its composition as determined by the scale is approximately 50 per cent tin and 50 per cent lead, or any other percentage desired.

CHAPTER XIII

Pewter Used in Place of Tin in Alloys

No. 1 pewter should consist of tableware and soda fountain boxes; but in any case must test 84 per cent tin. Syphon tops are to be treated for separately. Pewter is presumed to be an alloy of lead-tin-antimony-copper, and the average composition in former times, when it was extensively used, was tin 84 per cent, lead 10 per cent, antimony 5 per cent and copper 1 per cent. When the pewter contained much britannia metal, its composition was about tin 90 per cent, antimony 7.5 per cent, copper 2.5 per cent, or very close to the composition of genuine babbitt.

So far as appearance is concerned, britannia cannot be distinguished from pewter; but its identity can be arrived at from the service to which the article was devoted, as it has been found unwise to use for cooking utensils any alloy of soft metals containing 10 per cent lead. Britannia is made into such articles as teapots, coffee pots, sugar bowls, ladles, vases, platters, water pitchers, and other varieties of hollow ware. Originally these articles were silver plated, but the silver is usually gone by the time the article finds its way into the scrap metal market.

No. 1 pewter always has been considered a valuable scrap for brass foundry purposes; and when it was more easily obtained, large quantities were purchased and run into small ingots which were used for alloying in the place of tin. No notice ever was taken of the content of

antimony, lead, or copper in the re-run pewter, and as the scrap always was carefully sorted before being run down, the amount of lead it contained was small. As for the antimony, assuming that it would be 10 per cent, which would be the maximum, the amount added to the brass would be too small to work any harm, as it was rare that the re-run pewter was used for mixtures containing over 5 per cent tin. Of course, it never was used for making alloys where specifications had to be met, or high physical qualities obtained. For making red brass or composition, this material was satisfactory; and such alloys as ounce metal and red brass containing around 8 per cent of zinc, 3 per cent tin, and 3 per cent lead were made in great quantities by using No. 1 pewter in place of regular tin for ordinary brass castings.

For such castings as trolley ears and splicers, however, it should be used with caution, as the antimony might embrittle the alloy, so the castings would break as they were clinched over the wire. All scrap metals must be used with care.

No. 2 pewter is a different alloy than No. 1. The latter usually is found in the shape of some spun or stamped object, and No. 2 in the form of castings. No. 1 pewter is soft and can be bent, but No. 2 is likely to snap, particularly if it contains more than 13 per cent antimony. Its composition is lead and antimony, and it can be identified by its dark color resembling lead. It is not suitable for brass foundry alloying, or for making solder, because of its high antimony content. It can be used for making electrotype metal or for recasting into such articles as it originally was used for.

CHAPTER XIV

Type and Dross Valuable for Tin

Type metal dross comprises stereotype and electrotype drosses, that from stereotype metal being the more valuable of the two because it contains a higher percentage of tin. Stereotype metal contains from 6 to 60 per cent tin and from 5 to 18 per cent antimony, while the tin content of electrotype metal reaches a maximum at 5 per cent.

Type metal dross is of value only to the smelter, as it must be reduced to metal again in a suitable furnace.

The metal itself, once one of the standard white metal commodities, has now largely disappeared from the old metals market. Brass founders used to buy up old type and type metal of all kinds for use in making babbitts, and the various white metal mixtures used as pattern metals. But the foundry fails to get this material now as the type founders buy it all back again. As they can afford to give a better price than the scrap metal dealer, because they use it in making new type, it naturally has disappeared from the scrap metal market.

CHAPTER XV

Scrap Lead to be Used With Care But Tea is Pure

Scrap lead usually is found in the form of sheet lead cuttings and old lead pipe from plumbing operations. The latter comprises a varied assortment of water pipe, soil pipe, drain pipe, joints and traps. Scrap pipe frequently contains much foreign matter and water, which adds to its weight, especially when it is kinked.

Considerable caution is necessary in melting old lead pipe, because of the water it may contain. Such material should never be plunged carelessly into a bath of molten metal, as some very disastrous explosions have followed this practice, and trouble may be expected always, unless the pipe can be looked through from end to end to make sure there is no water or water absorbent material contained in it. Even when the pipe is seen to be entirely empty it is advisable to use a certain amount of caution in adding it to melted metal. The open end of the pipe should never be turned in the direction of any person when the other end is being introduced into melted metal, because should there be any dampness in the pipe it will cause it to act like a gun, and molten lead will be blown out of the open end.

Scrap lead should be carefully sorted, as it is possible that block tin pipe may have become mixed with it. If there are any brass parts, such as ferrules, they could be cut off. The joints are also to be removed, as

they consist of wiping solder, the composition of which is 2 parts lead and 1 part tin. These joints usually are removed by the scrap metal dealer, as they bring several cents more a pound than the straight pipe.

Clean scrap lead can be used in the foundry, but it is a question whether its use is much of an economy, as the price is little less than that of ingot lead. It is doubtful if there is any advantage in its use in brass castings, as the pig lead is much purer.

Scrap lead is very likely to contain antimony, and while this element is sometimes used in brass in place of tin, it can only be used in certain unimportant alloys, and then with great caution. For this reason it is better to use pig lead and take no chances, especially in view of the fact that there is so little difference in price of the two kinds of material.

Antimony finds its way into lead pipe from the scrap material used by many pipe makers, and tin is also found in lead pipe. Neither of these metals harms the pipe, as they stiffen it and make it more resistant to corrosive influences, but when the pipe is used as a source of lead it is better to have it pure.

When melting scrap lead a flux of tallow or resin should be used on top of the metal to disentangle the dross from the metal. A small amount of either of these fluxes is all that is required to clear the surface of the bath. When the molten lead has become thick from dissolved oxides a stick of green wood should be held in the bottom of the kettle, and the lead should be allowed to boil from the wood. This will reduce the oxides and restore the lead to its accustomed state of fluidity.

Tea lead is obtained from the linings of tea chests, and it is used for this purpose because it is the cheapest metal that could be obtained to enclose the leaves of tea and prevent access of moisture thereto, which would spoil the leaves. Tea lead is usually as pure as any grade of commercial lead. It is made from pig lead, since the consumption of lead in China for lining tea chests is so large that it probably exceeds the supply of lead, and, therefore, little scrap can be obtained. The tea lead always is shipped out of the country, and, therefore, is not available for use a second time.

Tea lead loses considerable on being remelted, as it is such thin metal, running from 0.010 to 0.005 inch in thickness, that a large surface is exposed to oxidation. The lead also is frequently covered on one side with paper, which further increases the loss. It usually is considered that the loss in melting tea lead is from 200 to 300 pounds to the ton, or from 10 to 15 per cent. In the case of paper-covered lead the loss will sometimes run over 18 per cent. It is advisable in melting tea lead first to have a bath of molten lead by melting pig lead and then to plunge the sheet lead under the surface of the bath. In this manner it is melted with the minimum amount of oxidation. If the bath of lead be not too hot the paper on the sheet lead will not be likely to cause an explosion.

Lead Dross

Lead always is more or less oxidized when it is melted, the extent of the change depending upon just how the temperature of the bath is regulated. A film of oxide

forms on the surface of the metal and when disturbed new surfaces are exposed to oxidation. No method of preventing the formation of this dross is known, and as the lead is skimmed the dross accumulates and is finally removed from the kettle and stored for sale to smelters.

The dross is never pure oxide, because considerable lead in a metallic state always is entangled therewith. An assay of lead dross generally shows a lead content nearly that of pure lead, as the oxide contains 92.82 per cent metallic lead, and it does not require much metallic lead to be mixed with it to increase this content considerably. Assays of lead dross show varying contents of lead, according to the condition of the dross, whether clean or dirty, finely divided or containing considerable spatters. The lead content varies from 95 per cent lead to 62 per cent lead, the latter dross being quite dirty.

It is possible to get most of the metallic lead out of the dross by putting it through a No. 20 screen. That which passes through the screen is largely oxide of lead, and that remaining in the screen includes spatters and shot, or metallic lead. In reclaiming the lead the oxide can be screened out of the dross and the screenings added to a kettle half full of lead, and just about red hot. The liquid lead melts and absorbs the finely divided lead, and the bath is cooled, and must be allowed to become hot again before a further addition of scrap can be made. A little tallow or resin melted in the bath greatly facilitates separation of lead and oxide

CHAPTER XVI

Aluminum Clippings Good for Castings

New sheet aluminum clippings must consist of new sheet aluminum and cuttings; must be free from oil, grease and any other foreign substances; and must be guaranteed not less than 98 per cent pure aluminum.

When sheet aluminum is compressed into briquettes little difficulty is experienced in using it for making aluminum castings; but it is difficult material to melt when loose, as the crucible contains only a small amount of each charge. A great deal of attention, therefore, is required and considerable metal always is spilled into the furnace. Hence, sheet clippings should always be shaped into massive forms. It is fairly good material for making castings when it has a purity of 98 per cent but it is similar to aluminum wire in that respect, as the specifications for this material require a purity from 98 to 99 per cent also. Aluminum wire is not difficult to charge for melting, providing that when cut into suitable lengths it is not permitted to untwist, if it be in the form of cable. Wire of single strand has to be coiled or compressed into bundles; otherwise, it is a most tedious operation to melt it into ingots or castings.

The cost of melting aluminum clippings or wire will depend upon their physical condition. In the case of loose wire in short lengths, produced by the untwisting of cut aluminum cable, the melting cost in a careful test

of 500 pounds of wire amounted to $2.62 per 100 pounds; and this was when labor was much cheaper than now. Included in this cost were labor, crucibles, fuel and loss; but the labor cost was more than all the other costs combined. The loss was 7 per cent. It will be realized that if finely divided aluminum is to be melted economically some method of forming it into packages of massive size is essential.

The metal, either wire or clippings, forms a good basic metal for ordinary castings and can be alloyed the same as the ingot metal, but, owing to the presence of a considerable amount of impurities, trouble from excessive shrinkage of the alloys is likely to arise more often than would be the case if pure aluminum were used. Unless the material be in good shape for charging into the pots its cost, when melted, would be near that of pure aluminum ingot; and this must be taken into consideration when deciding upon the particular kind of raw material to use for the work in view.

The temperature of the aluminum should be kept at about a red heat, and after the crucible is as full as desired, a flux of zinc chloride should be used to disentangle the oxide from the metal.

CHAPTER XVII

Aluminum Castings and Borings of Limited Use

The scrap metal specifications insist that aluminum castings shall be free from iron, babbitt, brass and any other foreign susbstance and must not exceed 2 per cent of oil and grease.

Aluminum alloys may be divided into two groups, those that contain zinc and those that do not. The first group may contain any amount of zinc from 1 or 2 per cent up to 30 per cent, with or without copper. The second group consist of alloys of copper and aluminum, with rarely more than 8 per cent copper, this latter alloy being known as No. 12 aluminum. Since both these groups are used indiscriminately for making aluminum castings it is obvious that an assortment of scrap will contain alloys both with and without zinc content. The result is that when melted it is impossible to keep the composition at all regular. Consequently, this chance must be taken when using this type of scrap metal.

Aluminum zinc alloys are not considered suitable for certain classes of aluminum castings, although in general they are stronger than the alloys of aluminum with copper. The aluminum zinc alloys shrink and check more than the aluminum copper alloys; and the higher the content of zinc in the alloy the more the tendency to shrink, until with over 30 per cent of zinc a peculiar shrinkage trouble is likely to manifest itself on the lower

parts of castings of heavy section. The result is that zinc is considered most undesirable in scrap aluminum, and if some easy and inexpensive method could be devised whereby the zinc could be eliminated from aluminum scrap it would be a boon to the scrap metal trade. The best that can be done at present is to allow the aluminum with zinc-free metals to bring the zinc content down to a point where, while undesirable, it is not harmful for most purposes.

For special purposes scrap aluminum castings are undesirable, but examples of castings where this material can be used to good advantage are numerous, as it is considerably cheaper than new aluminum or scrap rolled material. In the case of unimportant castings of such section as are easy to cast scrap aluminum is a desirable and economical material to use, and it can be run directly into castings after it is melted down. In some cases additional zinc can be added further to cheapen the alloy. This is not difficult, provided the scrap comprises castings of similar sort, like gear casings, instead of being a heterogenous mixture. In such a case the scrap will be of similar composition; and if a trial heat be made with zinc addition there will be little difficulty in deciding the amount of zinc to be added to cheapen the mixture.

Scrap aluminum castings are easy to melt and recast, as the metal is broken with ease and easily charged into the crucibles. The one thing to be careful of is to keep the temperature below a cherry red between the intervals of charging new metal. When the crucible is as full as desired a small piece of zinc chloride should be added

and stirred into the metal to clear the surface. When the alloy contains much zinc a little sal ammoniac has been found to do good, as this is the best flux to use in the case of zinc. For low zinc aluminum chloride of zinc is the best flux.

Aluminum borings, to avoid dispute, should be sold subject to sample. Aluminum foil, according to the specifications drawn up by the National Association of Waste Metal Dealers, shall consist of pure aluminum foil, free from paper and any foreign ingredients.

The composition of aluminum borings will naturally vary with the composition of the metal from which they were made. Therefore, in melting such material to produce castings, unless the origin of the borings is known, and consequently the composition of the castings from which they originated, it is not possible for the castings to conform to any particular analysis. A miscellaneous assortment of aluminum borings will produce castings of varying composition, unless they are thoroughly mixed and a sample is taken and run down and analyzed. Such material is only suitable for castings that are unimportant and of such shape that will permit free contraction without any portions being held by the sand, otherwise the castings will be likely to crack before they can be removed from the mold.

In using aluminum borings, and also aluminum foil, it is advisable to first run the borings into ingots and then remelt the ingots to produce the castings. In melting such material the losses are liable to run very high, unless skillfully handled. This is due to the fact that as each little particle of aluminum is covered with a

film of oxide a relatively large amount of oxide is mixed with the aluminum, and as the oxide, owing to the low specific gravity of the aluminum, fails to rise to the surface of the bath of metal it remains mixed therewith and produces a condition of pastiness in the aluminum.

Instead of being a bath of metallic aluminum there is produced a bath of metallic aluminum and aluminum oxide, or alumina, and the tendency of such a mixture is to take up nitrogen and convert both the metal and its oxide into a nitride. The metal is, therefore, lost, and a large amount of a grayish dross is produced, which consists largely of nitride. Fixation of nitrogen is very easily done by aluminum, which attacks its own oxide. This reaction occurs in an ordinary brass melting furnace, the things essential being carbon, which is furnished by the fuel, and the crucible and a chloride, which is furnished usually by zinc chloride, used as a flux. The reaction will proceed without the chloride, but it is greatly facilitated by its presence.

When a pot of aluminum borings is melted a pasty, metallic mass results at first. The addition of zinc chloride causes a reaction which separates the oxide, leaving the metal. At some spot around the sides of the crucible, or in contact with a piece of coke, if such is allowed to fall into the metal, a hot spot will develop and will spread until the entire dross on top of the crucible gets incandescent and at the same time grows more voluminous at the expense of the metal. In a short time most of the metal will be converted into this dross, resulting in an immense loss of aluminum. This loss can be prevented by paying no attention to the pasty

condition of the melting aluminum until the crucible is filled, and by keeping its temperature below a red heat; then, when ready to pour, the zinc chloride is added. The addition immediately produces sparks and liberates the aluminum from the oxide, the metal becoming liquid. At this stage the crucible must be removed immediately from the furnace, and the dross skimmed off entirely, and the aluminum ingoted.

This action will result in the minimum output of metal from the borings. The recovery by this method of melting aluminum turnings should run from 95 to 97 per cent of the weight of the borings charged, provided the latter were clean and contained no foreign matter. The aluminum, after being run into ingots, can be remelted for castings with very little further loss.

It is advisable in using ingot aluminum recovered from borings, buffings, and other finely divided aluminum, to add to the recovered metal a proportion of new metal, or scrap of known composition that previous to remelting was in massive form, and above all in a condition of cleanliness. When this method is followed no difficulty should be experienced in utilizing finely divided aluminum for casting purposes.

CHAPTER XVIII

Differences in Scrap and Battery Zincs

Scrap zinc must consist of clean sheet and cast zinc, also cast batteries, to be free from loose oxide and dross, sal ammoniac cans and other foreign materials. When sheet zinc is clean there is no objection to its use as a medium for adding zinc to brass mixtures, such as composition and ordinary yellow brass. The sheet can be folded and hammered flat, in which condition it is as easy to add to the alloy as the ingot zinc; but it wastes more, and allowance should always be made for this.

For use in making such alloys as manganese bronze, where the content of zinc must be kept within rather narrow limits to get certain physical properties, scrap sheet zinc should first be melted and run into ingots, when it can be used just as ordinary ingot zinc.

Scrap cast zinc from slush castings usually is a quite pure quality of zinc. This is necessary, as impurities in the zinc cause cracked castings, and the loss would be too heavy to enable an inferior grade of zinc to be used. Cast zinc may contain aluminum, but the content of this element always is low, and its presence may not be noticed on this account. In this case the cast scrap may be used freely in making brass mixtures.

Battery zinc, whether of cast or rolled material, usually is corroded, and the zinc itself generally poor in grade. It is liable, also, to be soldered or to have

attached copper or brass wire, screws and rivets, because it would not pay to attempt to remove these things. The zinc should be melted in a kettle, and it is probable that the corrosion products and the attached foreign materials will produce a thick scum upon the surface of the bath of zinc. This scum can be skimmed off by using a perforated ladle which will allow the clean metal to drain through and will retain the dross. After the zinc has been skimmed a flux of sal ammoniac should be thrown on and the bath well stirred. Sal ammoniac is the best flux for zinc, and its use will leave a clean surface.

If the zinc be thick it can be refined by introducing, by means of a phosphorizer, a mixture of sulphur, raw potatoes and leather scraps cut up and mixed together. The mixture is held by a handle attached to the phosphorizer at the bottom of the bath of metal, which will boil because of the gases that are liberated. The boiling must be kept up for 15 to 30 minutes, and in this connection it may be necessary to use several charged phosphorizers, as only small amounts of the refining mixture can be inserted in the bath in order not to cause the metal to spatter out of the kettle.

If there be any iron in the zinc this treatment will remove it, and as iron is what renders zinc thick, the result is that a fluid metal indicates a tolerably pure metal, sufficiently so for most brass foundry requirements, except for making such important alloys as manganese bronze. It is not advisable to add aluminum to zinc which has been remelted and ingoted and which is intended for brass foundry use.

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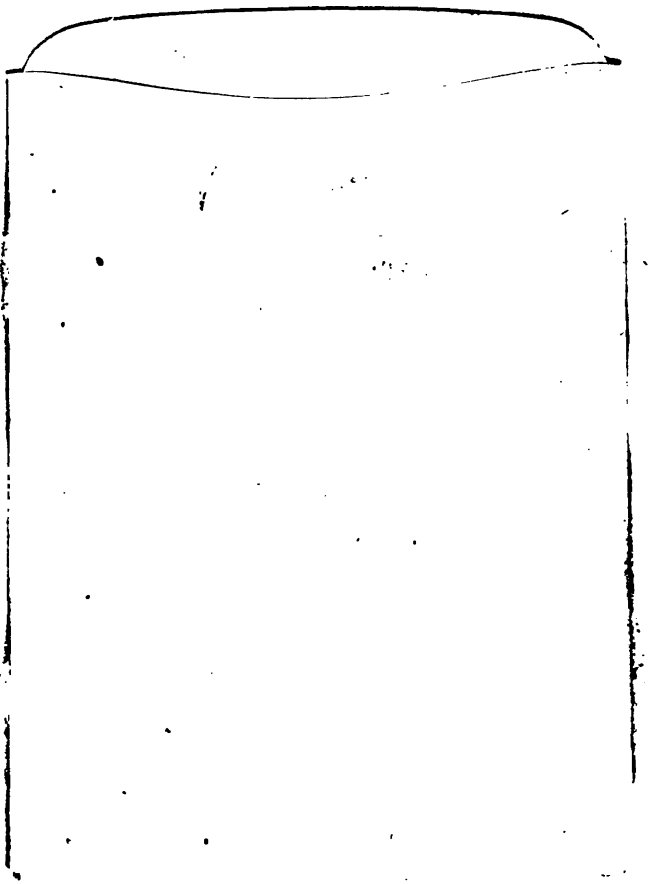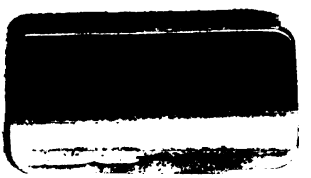
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